SCIENTIFIC AMERICAN

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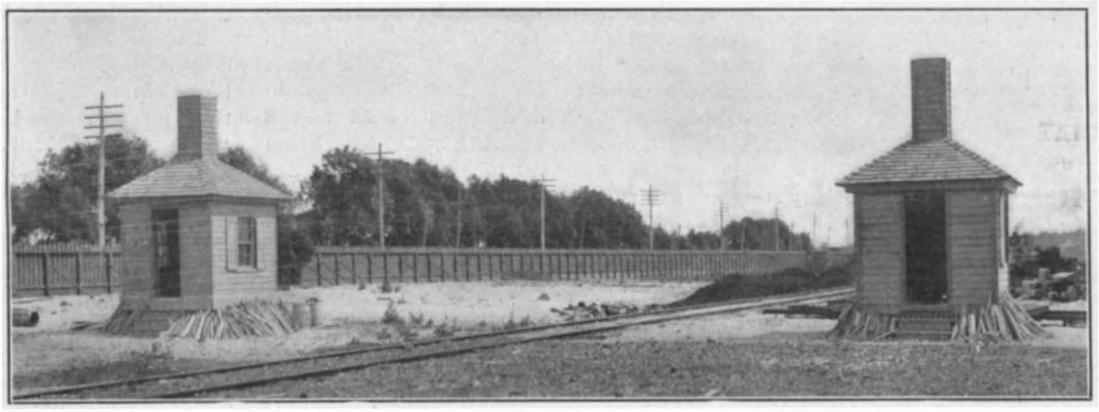
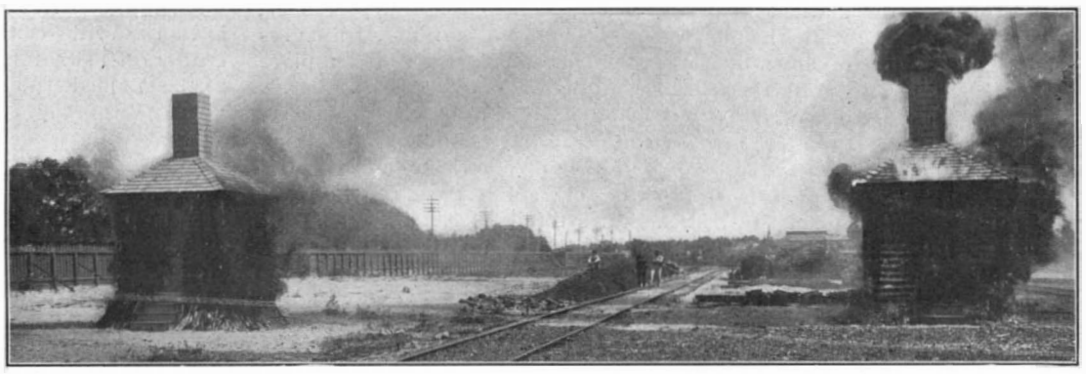
FIREPROOFING WOOD.

During the past few months numerous tragedies, due to destructive conflagrations, have given indisputable evidence of the value of any system of fireproofing that will retard, if not entirely prevent, the wholesale loss of life and property by fire. It is, perhaps, for the reason that naval and military matters always exercise a powerful controlling influence on commercial affairs, that the swift destruction of the Spanish squadron at Santiago did more to stimulate the search for a thorough and reliable fireproofing process than some greater conflagrations that had preceded Santiago. Be that as it may, the last two years have seen an unusual amount of research carried on in the matter of fireproofing, and some of the processes which have been devised have received full description in our columns. The recent tragedy at Hoboken, in which the docks and three of the vessels of the North German Lloyd Company were destroyed and several hundred lives lost by fire, has emphasized the urgent need for the application of fireproof methods, in constructing both the docks and wharves themselves and the ships which make fast to them; for one of the most important lessons of this disaster is that, if the docks and pier sheds had been of masonry and steel construction, or even being, as they were, of wood, had they been thoroughly fireproofed, the loss of life and property would have been greatly reduced.

The present article will be devoted to a description of the latest method of fireproofing wood, which has been invented and developed by Mr. Joseph L. Ferrell, of Philadelphia, and which for some time has been in successful operation in his hands at the plant of the United States Fireproof Wood Company, at 2220 Race Street, Philadelphia.



READY FOR FIRING.



AFTER TEN MINUTES' BURNING.

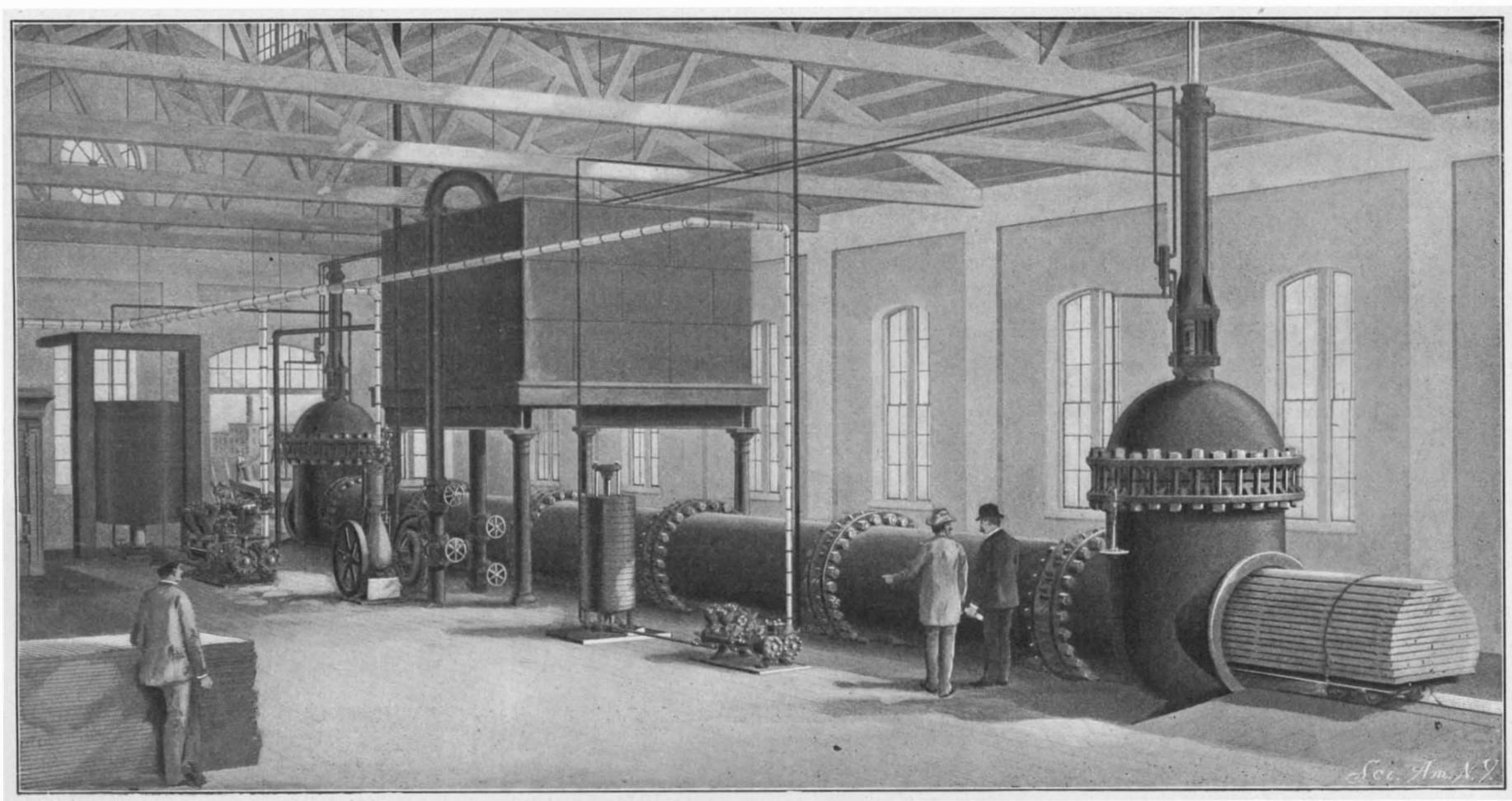
AFTER SIXTEEN MINUTES' BURNING.

Comparative Test of Fireproofed and Non-Fireproofed Wood.

The process differs from those which have preceded it chiefly in three important particulars. First that the wood is not subjected to any steaming or vacuum process for the purpose of emptying the cells of the wood by withdrawing the sap, preparatory to injecting the fireproofing liquor. Second, that the fireproofing liquor is forced into the wood under a much greater hydraulic pressure than has heretofore been used, or even attempted, with the result, as claimed by Mr. Ferrell, and it seems to us very properly so, that the fireproofing is not only accomplished with the least possible alteration of the physical properties of the wood, but owing to the extremely high pressures used, it is accomplished much more rapidly and with more perfect saturation. And, third, that by the intervention of the hydraulic accumulator an enormous pressure for the purpose of assuring heat treatment to hardwoods of all sections is communicated as beneficently to the wood as a very low pressure can be without the accumulator, besides ensuring great rapidity of saturation. Incidental to these improvements are certain mechanical improvements in the fireproofing plant, particularly in the design and operation of the gate of the receiver.

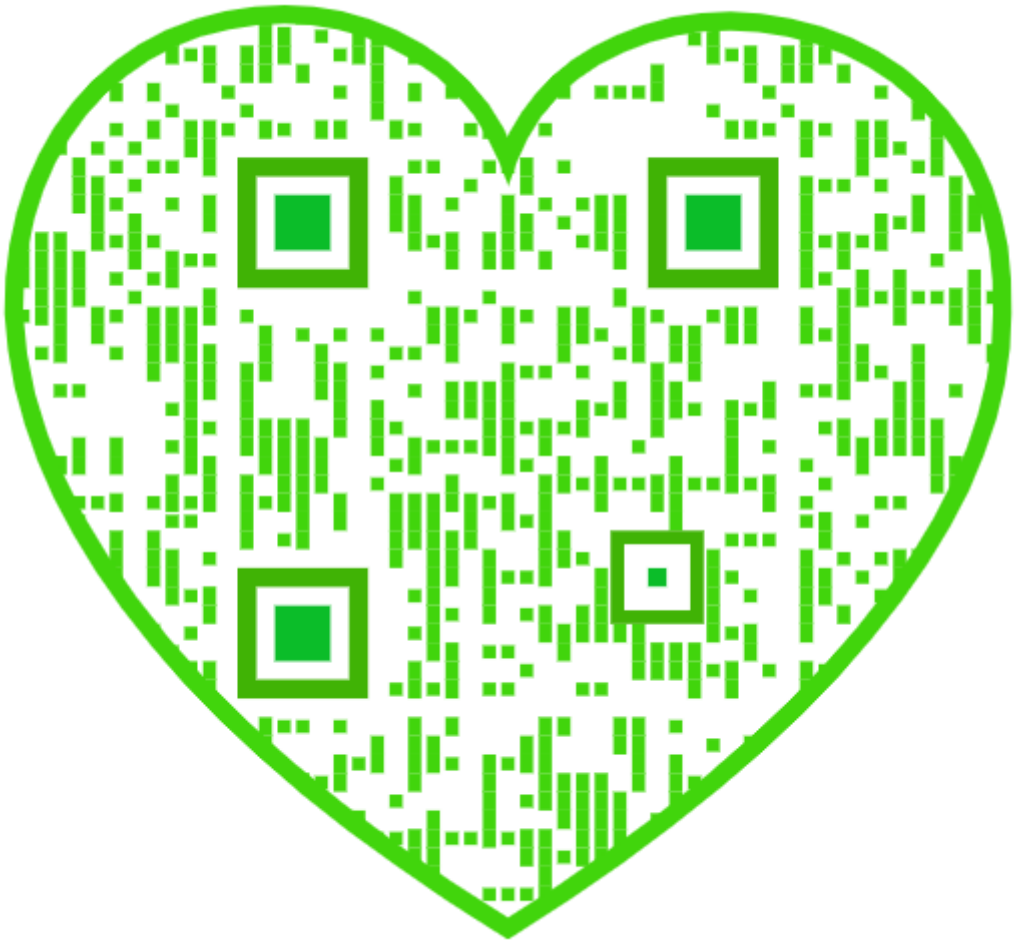
Although the working plant at Philadelphia was designed as a model plant to demonstrate the working of the new pro-

(Continued on page 55).



Single-Cylinder Plant, with Capacity of 15,000,000 feet per annum.

FIREPROOFING WOOD.



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THE END-OF THE-CENTURY STEAMSHIP.

The performance of the "Deutschland" in exceeding on her maiden trip all previous records for the westward passage across the Atlantic suggests that marine engineering has by no means reached the limit of its possibilities. Great as the development of the fast Atlantic steamship has been in the closing years of the nineteenth century, the present indications are that in size, speed, and, above all, in economy of performance, each successive vessel in the opening years of the twentieth century will continue to show the same all-round improvement over its predecessors.

By the courtesy of the Vulcan Iron Works, Stettin, the builders of the "Deutschland" and of Mr. Emil L. Boas, the General Manager of the Hamburg-American Company, we are enabled to give further particulars of the performance of this vessel, both on her trial trip and on her maiden Atlantic voyage. On the long distance, deep-sea trial, from the mouth of the Oder to the mouth of the Elbe, the mean indicated horse power was 35,200. On the run from Plymouth to New York, the average indicated horse power for twenty-four hours was 34,200. The merit of this performance is greatly enhanced by the fact that the total consumption of fuel for the twenty-four hours was 550 tons, which works out at the remarkably low figure of 1·5 pounds per horse-power-hour. The low consumption of fuel is attributed by the builders largely to the Howden system of forced draught with which the "Deutschland" is fitted. The draught, before entering the furnace, passes around a nest of tubes through which the hot furnace gases are drawn on their way to the smokestacks, the draught entering the furnaces after lowering the temperature of the uptake between 200 and 300 degrees. As to the possibilities of the future, it is probable that the "Deutschland," by the time these lines are before our readers, will have exceeded the eastward record, of which the average speed, made by the "Kaiser Wilhelm," stands at 22·6 knots; and when her engines have been limbered up by further service we may look for an average of 23 knots for the whole passage.

That the Atlantic steamship will continue to grow in size and speed is suggested by the three great ships which are now being built, two of them at the Vulcan Yards, Stettin, for the North German Lloyd Company, and one by Harland & Wolff, at Belfast, for the White Star Line. The particulars of these vessels are herewith tabulated in comparison with those of recent Atlantic liners.

ATLANTIC STEAMSHIPS BUILT AND BUILDING.

Name.	Owners.	Length in Feet.	Displacement, in Tons.	Horse Power.	Speed, in Knots.
Kaiser Wilhelm.....	N. G. Lloyd.....	649	20,000	28,000	22½
Oceanic	White Star.....	704	28,500	28,000	20½
Deutschland.....	Hamburg American..	686	23.000	54,200	23
Kronprinz	N. G. Lloyd.....	663	21.500	32,000	23
Kaiser Wilhelm II ...	N. G. Lloyd	705	26,000	38,000	23½
Unnamed.....	White Star.....	750	32,000	(?)	(?)

The North German Lloyd Company will first place in service a vessel, the "Kronprinz," which in size will come between the "Kaiser Wilhelm" and the "Deutschland," and in speed will equal the latter. She will be 660 feet long, of 21,500 tons displacement, and is to show a sea speed of 23 knots with 32,000 horse power. The other vessel, to be known as "Kaiser Wilhelm II.," is to be 705 feet long, of 26,000 tons displacement, with an indicated horse power of 38,000, and is to maintain a sea speed of 23½ knots. The North German Lloyd Company have not favored the use of superheated forced draught; but if, as is not unlikely, they are moved by the economical steaming of the "Deutschland" to substitute forced for natural draught, we shall expect to see this vessel average 24 knots after she has been a few months in service.

Although the "Kaiser Wilhelm II." will slightly exceed the "Oceanic" in length, her displacement, owing to her finer lines and shallower draught, will be less by about 2,500 tons. The White Star Company have never been greatly affected by contemporary practice in marine engineering, and have always followed a policy that was strictly individual and consistent. A quarter of a century ago they built, in the "Britannic" and "Germanic," the prototypes of the long, narrow, and speedy Atlantic liner of to-day. Recently, in the "Oceanic," they have instituted another distinct type, in which high speed and extravagant demand for boiler and engine space have given way to great cargo capacity and more generous passenger accommodation; while no attempt has been made to attain the exceptional speeds which have characterized the fast ships of the Cunard and the German lines. Hence, it is not probable that the huge vessel which is now being built at Belfast for this company will be any faster than the "Oceanic," although she will greatly exceed her in size. She is to be about 50 feet longer and 5 feet broader, with 3,500 tons increase in displacement on a draught of 32 feet 6 inches. Her length on deck will thus be 750 feet, beam 73 feet, and displacement 32,000 tons. In the absence of any statement to the contrary, however, the public will be curious to know whether the Belfast firm will be instructed to place sufficient engine power in this vessel to make her the swiftest as well as the largest of ocean liners.

OUR VAST RAILWAY SYSTEM.

The statistical report of the Interstate Commerce Commission shows that there has been a steady extension of the railway system of the United States, and a marked increase in traffic, both freight and passenger; while the more healthy condition of railroad finances is shown by the large reduction that has taken place during the year in the number of railways in the hands of receivers, there being but seventy-one such roads on June 30, 1899, as compared with ninety-four on the corresponding date of the previous year.

On June 30, 1899, the total single-track railway mileage of the United States totaled 189,895 miles, an increase during the year of 2,898 miles, which is greater than that of any other year since 1893. The total number of locomotives was 36,703, an increase of 469 over last year. The total number of cars of all classes in the service of the railways was 1,375,916, an increase of 49,742. Of these 33,850 were passenger cars, 1,295,510 were freight cars and 46,556 were devoted to the direct service of railroads. It must be remembered, however, that cars owned by private companies and firms, used by railways, are not included in these returns.

The number of employés was 928,924, an increase of 54,366. Of this total number the service of 34,900 employes was required for general administration, 287,000 for maintenance of way and structures, 181,000 for maintenance of equipment, and 418,000 for conducting transportation.

The total amount of railway capital outstanding was over $11,000,000,000, representing a capitalization of $60,566 per mile of line. The total amount of dividends declared during the year was $111,900,822, which would be produced by an average rate of 4·96 per cent on the stock on which some dividend was declared.

The gross earnings were $1,313,610,118, an increase of over $66,000,000 for the year. The operating expenses were $856,968,999, an increase of $39,000,000. The amount of dividends declared during the year was $111,000,000, leaving a surplus of $53,000,000, the corresponding surplus of the preceding year being $44,000,000.

The total number of casualities during the year was 51,743, of which 7,123 were killed and 44 620 were injured. The number of passengers killed during the year was 239 and the number of injured was 3,442. During the year no less than 4,040 trespassers were killed, and a slightly larger number injured. At highway crossings alone 693 were killed and 1,125 injured. The statistics of injuries to railway employés continue to be the painful feature in the annual statistics, for with reference to trainmen, in which term are included enginemen, firemen, conductors and other trainmen, it is shown that 1 out of every 155 was killed and that 1 out of every 11 employed was injured. In view of the great risks run by employés, it is gratifying to note that, thanks to the efforts of the Commission, the work of equipping cars with automatic couplers and other attachments calculated to reduce the list of casualities, is proceeding rapidly, for, of the 1,295,510 cars in the freight service, 730,670 were fitted with train brakes and 1,067,000 with automatic couplers.

INCREASE OF OUR NAVY SINCE THE SPANISH WAR.

A request from a subscriber for a statement of the new vessels that have been authorized for our navy since the publication of the SCIENTIFIC AMERICAN NAVY SUPPLEMENT, suggests to the editor that this information will be generally welcomed by those of our readers who include the NAVY SUPPLEMENT in their files.

BATTLESHIPS.—Beginning, then, with the battleship class, we have the "Maine," "Missouri," and "Ohio," authorized May 4, 1898. They are of 12,300 tons displacement and 18 knots speed; are protected with 11-inch armor on the belt, and 12-inch on the barbettes and turrets; and will carry four 12-inch B. L. rifles and sixteen 6-inch rapid-fire guns besides twenty-six 6-pounders and automatics.

Following these come the ships of the "Georgia" class, the "Georgia," "New Jersey," and "Pennsylvania," authorized March 3, 1899. These vessels are to be of 14,650 tons displacement and 19 knots speed. The belt will have a maximum thickness of 11 inches, and the gun positions will be protected with from 11 to 6½ inches of armor. After lengthy discussion, it has been decided to provide these vessels with the double-deck turret, arranged as in the "Kearsarge," and the armament will consist of four 12-inch and four 8-inch B. L. rifles; fourteen 6-inch and twelve 3-inch rapid-fire guns, besides thirty 3-pounders and machine guns.

The present Congress has recently authorized the construction of two more battleships of equal size, to be known as the "Virginia" and "Rhode Island." In them a return is to be made to the turret system of the "Oregon" and "Iowa," the intermediate 8-inch battery being mounted in four separate turrets at the four corners of the central citadel. The particulars of these vessels will be 14,650 tons displacement; 19 knots speed; 11-inch belt; 11 to 6½-inch armor on gun positions; main battery, four 12 inch; intermediate battery, eight 8-inch; secondary battery, twelve 6-inch, and twelve 3-inch rapid-fire guns, besides 30 smaller guns.

The five battleships last mentioned are at present on paper the most powerful and best protected ships in the world.

ARMORED CRUISERS.—On March 3, 1899, Congress authorized the construction of three large armored cruisers of 13,000 tons displacement and 22 knots speed, to be named the "California," "Nebraska," and "West Virginia." Three more of the same size and speed, which were authorized by the Congress of 1899–1900, are to be called the "Maryland," "Colorado" and "South Dakota." The Board on Construction has been so preoccupied with the discussion of the battleship designs that the details of these vessels are not even yet definitely decided, but it is probable that the whole six will be built from the same plans and embody the following features: Displacement, 13,000 tons; speed, 22 knots; protection, a curved deck associated with a continuous belt of 6-inch armor; armament, four 10-inch long-caliber rifles mounted in two turrets fore and aft, and sixteen 6-inch guns mounted within casemates in broadside. These vessels will have an exceptional steaming radius. The last Congress also authorized the construction of three 8,000-ton protected cruisers. These vessels will carry, probably (the matter is not definitely settled), four 8-inch rifles in two turrets fore and aft, and either twelve or fourteen 6-inch rapid-fire guns in broadside casemates. In working out the plans of these ships an effort will be made to reserve sufficient displacement for armor to allow a continuous belt to be used at the waterline, thus placing these fine vessels, which are to be of 22 knots speed, in the armored cruiser class.

HARBOR DEFENSE MONITORS.—On May 4, 1898, the construction was authorized of the four single-turret monitors, "Arkansas," "Connecticut," "Florida," and "Wyoming," of 3,235 tons displacement, and 11½ knots speed, with 11 inches of armor on sides and barbettes, and armed with two 12-inch rifles and four 4-inch rapid-fire guns.

SEMI-PROTECTED CRUISERS.—On March 3, 1899, a batch of six somewhat nondescript vessels was authorized, which, although they appear in the official list as protected cruisers, are not really so—the protective deck extending only throughout the middle portion of the vessels, the ends of the deck, as in the early "Chicago" and "Atlanta," being unarmored. These vessels moreover, because of their extremely low speed, are scarcely eligible to be classed in the cruiser classes, where the speed is invariably in new vessels from 21 to 23 knots. The six vessels are known as "Chattanooga," "Cleveland," "Denver," "Des Moines," "Galveston" and "Tacoma." They are 3,200 tons displacement, 16·5 knots speed, and carry a battery of ten 5-inch rapid-fire guns and a dozen 6-pounders and machine guns.

TORPEDO BOAT DESTROYERS, ETC.—The same bill of May 4, 1898, mentioned above, included sixteen torpedo-boat destroyers and twelve torpedo boats, all of which are now either nearing completion or afloat. The destroyers are seagoing craft of 420 to 433 tons displacement and 28 to 30 knots speed; the torpedo boats are from 157 to 340 tons displacement, and vary in speed from 26 to 30 knots.

SUBMARINE BOATS.—The last Congress, impressed by a somewhat favorable report by a board appointed to test the capabilities of the Holland submarine boat, authorized the construction of six vessels of this type, but enlarged and improved.

Of the fleet of vessels outlined above, sixty-one in all, it may be said that as far as the battleships, armored cruisers, and torpedo craft are concerned, the designs leave little to be desired. The armored vessels are particularly fine, being large, fast, amply protected, powerfully armed, and possessing great coal capacity; but one regrets that the appropriation voted and being expended on the monitors, submarine boats, and semi-

protected cruisers (about $11,000,000 altogether) is not being expended on more up-to-date and serviceable vessels. For the same sum we might have secured four first-class battleships, or four armored cruisers of the "California" type, a squadron of infinitely more value than the abnormal vessels to the construction of which the nation is now committed.

THE HEAVENS IN AUGUST.

BY HENRY NORRIS RUSSELL, PH.D.

The steady eastward march of the sun through the skies brings the same constellations to the meridian ever earlier in the evening. The aspect of the fixed stars in one month is repeated in the next, with the sole difference that they rise and set two hours earlier by clock time, so that the description of the heavens as seen at 10 P. M. in the middle of July holds good also for 9 P. M. on August 1, 8 P. M. on August 15, and so on (except, of course, as regards the moon and planets).

There is, therefore, no radical change in the appearance of the skies from month to month. The constellations near the meridian are a little farther west than they were a month ago, some old friends among the stars have vanished in the west, and new ones have risen in the east to take their places, and that is all.

At 10 P.M. on August 15, Cygnus, Lyra and Aquila are near the meridian, the first two being almost overhead and the third farther south. Hercules and Ophiuchus are to the west of the meridian, with Arcturus and his accompanying stars still lower, and the paws of the Great Bear are just touching the northwestern horizon. Between Vega and the Dipper is Draco, bending his ungainly length around the Little Bear.

The zodiacal constellations offer little of fresh interest. Scorpio and Sagittarius are passing westward, carrying Jupiter and Saturn with them. Capricornus, Aquarius and Pisces are all inconspicuous, and the triangular head of Aries is only just rising.

About half-way up the eastern sky is the great square of Pegasus, which can be recognized at a glance. From its northeast corner runs a curving row of second magnitude stars, spaced at intervals about equal to a side of the square.

The first is Beta Andromedæ, and the second Gamma of the same constellation, while the third is Alpha Persei. Above Bela Andromedæ is a small star, and as far again in the same direction the great nebula of Andromedæ can easily be seen with the naked eye. Forming a right-angled triangle with Alpha Persei and Gamma Andromedæ is the "Demon Star," Algol, one of the most remarkable known variables.

The Milky Way spans the heavens completely, passing through the zenith. There is a condensation in it between Cassiopeia and Perseus which is worth looking at with a field glass or *à fortiori* with a telescope, as it is a very fine star cluster.

THE PLANETS.

Mercury is morning star in Cancer throughout August. He is too close to the sun to be seen in the earlier part of the month. On the 18th he reaches his greatest elongation — 18° 32′ — which is much less than the average, because he is near perhelion. In consequence of this he rises only about an hour before the sun, and though bright will be hard to see.

Venus is also morning star in Taurus and Gemini, rising about two hours before sunrise on the 1st, and three hours on the 31st. On the 13th she attains her greatest brilliancy, and is easily visible in the daytime, though difficult to find.

While speaking of Venus, it should be noted that the recent spectroscopic investigations of Belopolsky indicate that she rotates on her axis in a period of about a day—not in the much longer period of 223 days, as has recently been believed.

Mars is morning star in Taurus and Gemini, and rises from four to five hours before the sun. He is steadily growing brighter, but is still twice as far off as the sun, and is, therefore, faint.

Jupiter is evening star in Scorpio. On the 25th he is 90° from the sun, and comes to the meridian at 6 P. M. The present month is a favorable time for telescopic observation of the eclipses and transits of his satellites, as the eclipses take place at their greatest apparent distance from the planet. About 9 o'clock on the evening of the 25th the 2d satellite is in transit, and the 1st and 3d are occulted by the planet, so that Jupiter will appear to have but one satellite,—a rather unusual occurrence.

Saturn is in Sagittarius, and is well up in the south at sundown. His rings are very widely opened out, and with his satellites they form a magnificent telescopic spectacle.

Uranus is in Scorpio, not far from Jupiter, and Neptune is morning star in Taurus, but invisible to the naked eye.

THE MOON.

First quarter occurs on the afternoon of the 3d, full moon on that of the 10th, last quarter on the morning of the 17th, and new moon on that of the 25th. The moon is nearest to the earth on the 12th, and most remote on the 27th. She is in conjunction with Jupiter on the morning of the 5th, Uranus the same afternoon, Saturn on the morning of the 7th, Neptune on the evening of the 19th, Mars on the afternoon of the 20th, Venus on the morning of the 21st, and Mercury on that of the 23d.

AN INTERNATIONAL EXHIBITION AND RACE-MEET AT CHICAGO.

An automobile exhibition and race-meet will be held at Chicago in September, under the auspices of The Inter-Ocean Publishing Company. It will be remembered that the first automobile race in the United States was conducted by The Inter-Ocean, in 1894. The tests, races and exhibitions will be held at Washington Park from September 18 to September 22 inclusive. The events will take place in full view of the spectators. A brilliant system of electric lighting is to be arranged for night racing. The grand stands have a capacity of 50,000 and the transportation facilities are unexcelled. It is thought that the events will attract international attention. As at present arranged for, they will be as follows. Suggestions as to changes may be made up to August 15, when the programme will be finally adopted.

On the opening day there will be a general parade of nearly five hundred vehicles, with standing and moving exhibition, when the general public will be allowed to examine the vehicles in and out of the buildings, and ride in them in the parks. Prizes will be given to the manufacturer presenting the greatest number of practical designs and to the manufacturer having the greatest number of automobiles in line. A special prize will be given for the most practical design of wagon for general purposes.

The second day will be the commencement of the tests for general practical utility. All the different forms of power will be classed together and vehicles of each different rating of power will be awarded honors and prizes in competition only with vehicles of like size. The carriages or wagons entered for practical utility must be of standard design, construction and equipment as regularly catalogued by each manufacturer. In tests of practical utility each manufacturer will be allowed to enter three vehicles, one vehicle carrying two people and operated by the owner of the vehicle; one vehicle carrying four or six people and operated by the owner or servants in livery; one vehicle designed for commercial or merchandise delivery purposes, carrying a load of not less than 1,000 pounds with driver, nor more than 2,500 pounds with driver. The award will be made in the ratio of load and weight of vehicle.

In testing the practical manipulation of vehicles, a series of dummy figures will be introduced on the tracks, some will be constantly shifted, some remaining permanent as the vehicles pass through them, causing frequent and sudden stops and turnings, to show the safety of the vehicles in crowded thoroughfares and the dexterity which may be obtained by any intelligent operator. There will also be provided a section of extremely rough and uneven roads, with mud and chuckholes, and country road ruts, with logs, stones and obstructions, requiring short stops and turns, and including both up and down grades, corresponding to country roads and city streets. These tests will be of inestimable value to the automobile industry.

The points will be as follows: Speed (to be determined on a five-mile run), 20; elegance of carriage design and practicabillty, 20; best arrangement of brake and control of speed, 20; best climbing of grades, 20; best and surest safety devices for operating vehicles either on grades or level, 10; best, simplest and most easily accessible mechanical construction, 10.

There will be a hill-climbing contest, also a contest on an incline and decline grade, in which practicability and controllability of the vehicle will be demonstrated.

There will be a heavy draught contest, open for all heavy draught motor trucks built for commercial hauling. Their points will be as follows: Construction, 20; power, 20; carrying power, 20; design, 20; control, 20.

After decisions have been rendered on tests covered by the above rulings, the prize winners of each class will be allowed to open competition on: Carriage design for general practical utility counting 30 points; easiest manipulation, 30 points; safety and emergency devices, 20 points; cost of power per ton mile, 20 points.

The cost of electricity is to be based on 4 cents per kilo-watt hour; cost of gasoline or oil will be based on the current price per gallon.

Manufacturers will be obliged to give the normal rated power of each vehicle, and a special prize will be awarded for the greatest range of useful power obtainable above and below the normal rating. One prize will be offered for the most original conception in an automobile as regards modification, and changes in carriage designs that will still leave the vehicle acceptable and practicable. This is without reference to power.

Four races will be run, in which speed alone will count for 100 points. Each manufacturer is to enter two vehicles of such design and equipment as he may select that shall pertain to the class of vehicles manufactured by him.

There will be a race of 20 miles between steam vehicles; a race of 20 miles between electric vehicles; a race of 20 miles between gasoline vehicles, and any disabling of a vehicle during a race will disqualify it for further participation during that race.

The prize winners of each race will then enter into a "free-for-all" of 40 miles, where speed will count for 100 points.

The time will be kept for each mile and an extra prize will be given to the vehicle making the best single time during these races.

There will also be a 200-mile "free-for-all" fast track race for owners carrying four grown people; also a 200-mile track race carrying two people.

Another important feature of the exhibition will be a mail race. Four mail boxes will be placed at equidistant points around the race track, and ten miles will be run, making forty stops in all, to collect the mail. Each driver will be obliged to stop at each box, unlock it and take a card from the same and lock it again. The vehicle making the best time in the forty stops in the shortest space will be awarded the first prize, and the driver will receive a bonus.

There will also be a ten-mile practical road race on a rough track constructed to represent an average country road, the carriages to hold four people. There will also be a ten-mile road race, the vehicles carrying two people.

An additional prize will also be given for a design for a mail wagon which shall be the most practical and the best adapted for the collection of mail matter from street boxes.

There will be a 500 mile smooth track road race "free to all," to be run on the fourth day, commencing at 5 A. M., 100 points being for speed. Exhibition performances will take place on the inner circle while this race is in progress. This will be followed by an automobile transfer express race, which is to be run five miles, taking a swinging bag from suspended hooks from four points around the track without stopping. The man coming in first with twenty of these bags will be awarded the first prize. The test will be open to all classes of vehicles.

Ladies' day will be full of interest, as ladies will have the track exclusively in a series of races, which will be run with carriages and not racing vehicles. In addition to this, the most dexterous lady operator in dodging the dummy figures, climbing grades, and general manipulation of the vehicle will receive a special gold medal. A gold medal will be awarded the operator of vehicles of the commercial and catalogue type who performs the most difficult tests and practical movements.

This will be immediately followed by an exhibition of vehicles owned exclusively by private parties, which will be open and "free for all" in a four-mile race. A second prize will be given to the most dexterous operator, and a third prize to the best appearing vehicle. This race to be followed by an open and "free-for-all" exhibition of fancy and trick driving. There will also be a pulling contest, free for all, the award to be made in ratio of weight, power and performance.

To demonstrate the value of the merchandize delivery wagon a race of three miles will be run, having eight stations on alternate sides of the track, at each of which must be left a package weighing not less than 20 pounds. Each wagon will be allowed a driver and assistant, as is the usual practice on such wagons. The wagon will not be required to come to a full stop, but the winning vehicle must arrive at the finishing point with all of the packages delivered and the driver and assistant in their proper places.

After the races are over a grand prize of $1,000 will be offered to the most valuable invention in automobiles that shall have been practically demonstrated during the week of the exhibition.

Among the novel features on daily exhibition will be a passenger vehicle which will be given one-eighth of a mile start of a second vehicle, the latter overtaking the first, and a complete exchange being made of drivers, baggage and passengers, with the vehicle running at full speed. This is considered one of the most difficult feats in automobile driving. This will be immediately followed by a race of automobiles running backward at full speed. The latter race will be open to any and all kinds of vehicles.

In all, $10,000 is to be awarded in prizes, and is to be apportioned to the events at the time of the final adoption of the programme. Bands of music will be in constant attendance and superb decorations will make a most brilliant scene.

The exhibition and races will doubtless bring large numbers of persons from all parts of the country to witness them. The races have been arranged with special attention to bringing out the good points of automobiles, and to assist in developing the industry. In this respect the regulations are most admirable and the results of the races will be looked for with the greatest interest.

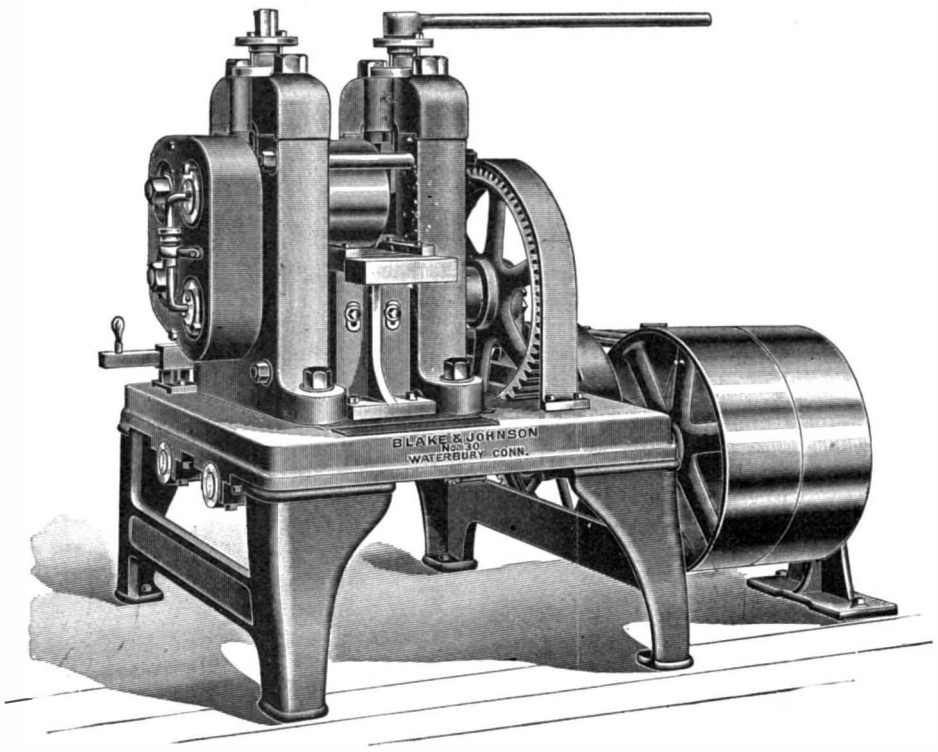
A LARGE WATER ROLLING MILL.

Perhaps the largest mill of its kind ever built for the purpose of flattening round metal has been designed by Messrs. Blake & Johnson, of Waterbury, Conn. Apart from its size (it weighs 4,200 pounds), the machine is distinguished from similar apparatus of its kind by certain novel features of construction.

Of these features the most noteworthy is the use of a pair of intermediate auxiliary gears (seen at the left side of the machine in our cut), whereby the rolls can be separated to admit ¾-inch rods. Usually the two roll-arbors are geared together, one gear being used on the end of each arbor, thereby allowing the rolls to be separated only a short distance, since the gear-teeth would otherwise be weakened. The advantages of the new arrangement over the old are therefore obvious.

The rolls are 10 inches in diameter and 6 inches face. In their construction flawless Krupp roll steel is used, perfectly hardened, ground, and lap finished. The arbors are made of steel and are bored the entire length. Water is allowed to circulate through both arbors and rolls, so as to prevent heating and to insure accurate rolling. The driving shaft is supported at the outer end by a heavy floor hanger, and is fitted with tight and loose pulleys.

The mill is particularly serviceable to manufacturers of flat wire and articles made from flat wire, because the larger the diameter of the rolls, the smaller will be the elongation of the wire, and the greater the width. Rolls of small diameter lengthen more than they broaden the wire; and for this reason the machines in which they are used do not always meet the requirements of the manufacturer.



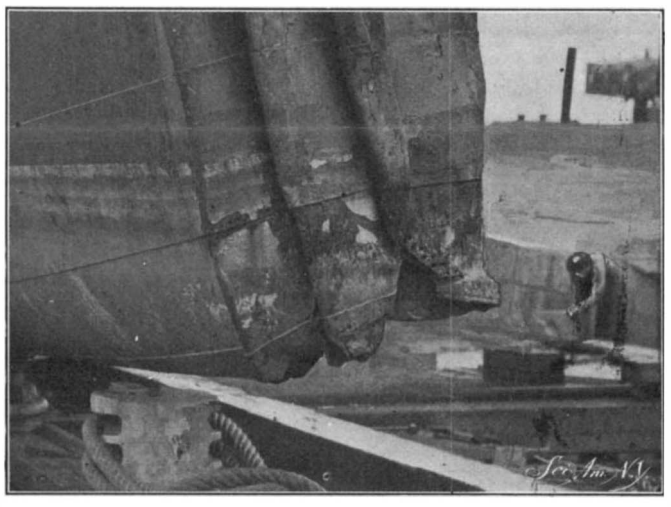
WATER ROLLING MILL.

ACCIDENT TO THE TORPEDO-BOAT "DUPONT."

If one were in search of ocular evidence of the fine quality of steel which is used in the construction of torpedo boats, he could not do better than study the crumpled up bow of the torpedo boat "Dupont," as shown in the accompanying illustration. It will be seen that the plating has been folded back on itself, concertina-fashion, so that the whole of the forward compartment, which was about 8 feet in length, has been compressed within a space of not more than 2 or 3 feet. This was an extemporized "cold-bending test" that speaks well for the quality of the material. Not only does the mild, open-hearth, steel, of which the thin ⅛-inch plates are composed, fail to show a single crack in any of the folds or laminations, but the riveted joints of the plating in many cases are not even started.

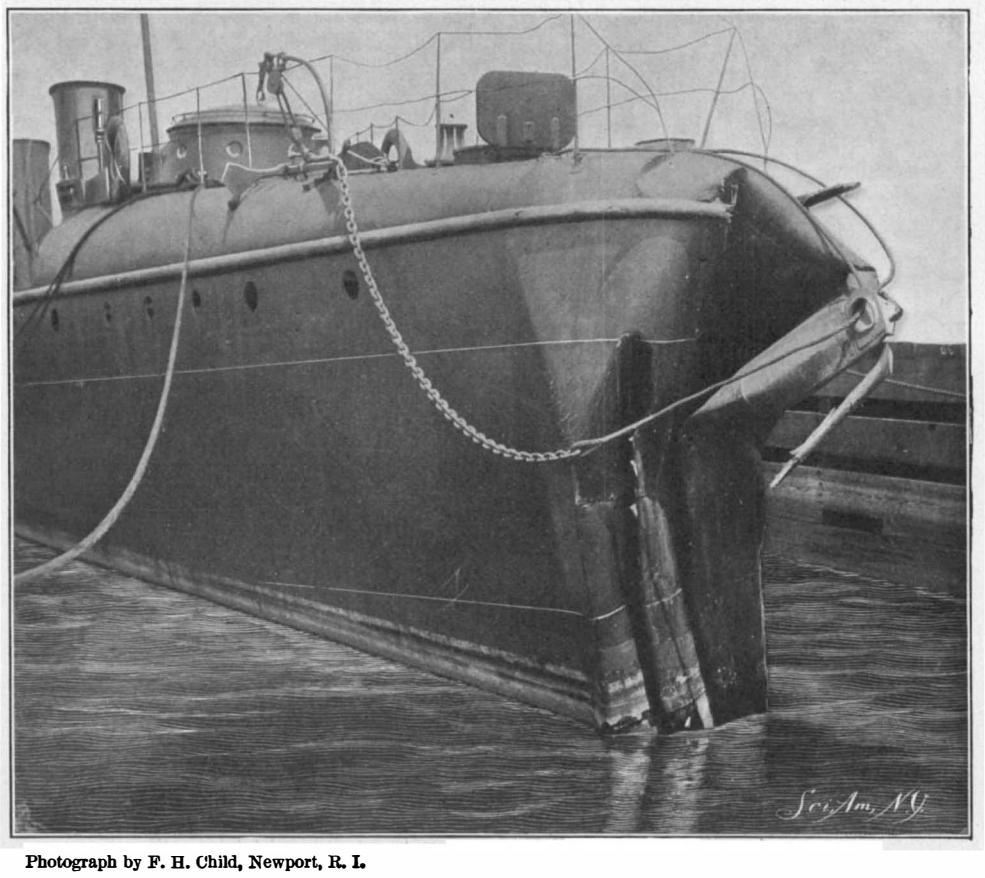
Although to the lay mind the fact that the plating of the "Dupont" should submit to such rough usage without a sign of fracture is very astonishing, it is well understood by builders of torpedo boats and other naval craft that this test is not nearly as severe as that which the plates have to undergo before they are accepted and built into the vessels. Thus, for instance, in the cold-bending test, two pieces cut from each heat during the manufacture of the steel must be capable of being bent over flat upon themselves, without showing any sign of fracture on the outside of the bend; while in the quenching test the specimens are heated to a dark cherry-red, plunged into water at eighty degrees Fahrenheit, and then must submit to be bent over a piece of their own diameter without fracture. This, it will readily be seen, is far more severe than the treatment to which the plates were subjected in the collision.

The accident to the "Dupont" happened at Newport when the craft was being brought into her berth. Ordinarily in bringing these little craft to their moorings, they are run into the dock at a speed of from 10 to 12 knots, and when a given point on the vessel passes the end of the dock the bell is rung for full speed astern. Such is the power of the engines that the craft is brought to rest as soon as the stern has passed within the pier head. On this particular occasion the signal was given about a second too late, with the result that the "Dupont" struck the end of the dock when she was yet traveling about four knots an hour. As it happened, the bow served as an excellent buffer, bringing the vessel gradually to a rest without dislocating the steampipes, boilers or engine fittings. It is a remarkable fact that, although the crumpling of the bow extended to the first watertight bulkhead, the latter remained practically watertight, and the little vessel, had she been at sea, would have made the trip to her dock with safety.



Photograph by E. Muller, Brooklyn.

FOREFOOT OF THE "DUPONT" AFTER THE COLLISION.



Photograph by F. H. Child, Newport, R. I.

UNITED STATES TORPEDO-BOAT "DUPONT"; SHOWING BOW COMPARTMENT CRUMPLED UP BY COLLISION WITH DOCK.

International Yacht Races at Paris.

The first of the international yacht races, held near Paris in connection with the Exposition, took place at Meulan. The races were open to yachts not exceeding 10 tons, and were divided into five series, 0 to ½, ½ to 1, 1 to 2, 2 to 3, 3 to 10 tons. A great number of boats were assembled on the first day, 66 in all, including American, German, English and other yachts. The first day's races were, however, deprived of interest by a dead calm which prevailed, and it was only on the second and third days that the real interest began. On the second day a number of races took place between the yachts of the different series, and among the victors were some of the boats well known in Mediterranean regattas. Of the 2 to 3 ton series, the race was won by "Ollé," belonging to M. Exshaw, over "Favorite," "Gwendoline," and others; of the 1 to 2 ton series, "Lerina," of Count de Pourtales, won, followed by "Martha," of M. Vilamitjana, "Nina Claire," and others. The third day was devoted to the races for the Coupe International de l'Exposition; this cup, by the sculptor, Belloc, executed in silver by M. Linzsler, is a veritable work of art. It was allotted to the second series, from ½ to 1 ton, and 32 yachts were assembled. A fine contest took place between the English yacht "Scotia" and the German yacht "Aschenbrodel," which started together and kept very close during the whole of the race, followed by the small racer, "Crahe II.," designed by M. Valton. The victory fell to the German yacht, which came in first with scarcely a second's advance over the "Scotia;" it was, however, gaged officially and found to exceed the limit of one ton, being thus disqualified. Accordingly the cup was awarded to the "Scotia," which is owned by Messrs. J. H. Gretton and Lorne Currie.

Piercing of Limestone by Snails.

M. Stanislas Meunier has observed the fact that limestone rocks near Constantine, Algeria, are pierced with holes by snails, which use cavities thus formed as a shelter from the summer heat. In the same connection, M. Edouard Harlé has observed an analogous fact at Salies-du-Salat, in France; calcareous rocks of compact structure or marble present here and there groups of cylindrical holes as large as the thumb; according to the inhabitants, these holes are made by a species of snail, and several of these were found lodged in them. Cases of this kind have been already observed, and as far back as 1854 M. Constant Prevost gave an account to the Académie des Sciences of a series of cylindrical holes made by snails in the limestone rocks at Monte Pelegrino, in Sicily. These holes are from three to four inches long and have diameters varying from one-fifth to two inches, according as they were made by young or adult specimens. Near Boulognesur-Mer he observed hard limestone rocks which had been perforated with circular holes, grouped on the inner or less exposed faces of the rocks, these being from five to six inches deep and having a slight upward slope to prevent the accumulation of water. The snail in this case is the Helix hortensis, and it passes the winter there. In the neighborhood of Salies-du-Salat there are numerous rocks perforated in this way, and in the spring they contain a great many inhabitants. The snails seem to be the Helix nemoralis and the Helix hortensis. The holes occur generally in groups, and are often so close together that the partition wall is pierced and destroyed wholly or partially. As to the manner in which the snail is enabled to perforate the rock, no satisfactory conclusion has been reached.

THE burial grounds of the Ming dynasty are of great interest. The Holy Road is the most interesting feature of the burial grounds. It is lined on both sides with colossal monolithic statues standing about 200 yards apart. There are thirty-six statues of which twenty-four represent animals and twelve high dignitaries. The statues are by no means crude. The statues are made without pedestals and are disposed in groups of four each; four lions, four rams, then camels, elephants, horses and chimeras. In each group two animals are shown standing and the others lying down. They are fully illustrated in the current issue of the SUPPLEMENT.

THE ELECTRICAL PLANT OF THE JEFFERSON PHYSICAL LABORATORY.

BY JOHN TROWBRIDGE, PROFESSOR OF PHYSICS, HARVARD UNIVERSITY.

The Jefferson Physical Laboratory of Harvard University has at present the most extensive plant for the study of high tension electricity in the world. It consists of 20,000 storage cells with transformers which can exalt the normal voltage of these cells—44,000 volts—to 6,000,000. A higher voltage could be obtained, but I have discovered that even 3,000,000 volts is not realized in the length of the electric discharge which should be—10 feet—as long as the apparatus is enclosed in a room with walls of brick. It will be necessary, if the effects of high voltage are to be studied in regard to their full disruptive effects, to place the apparatus in an open field, and at least 30 feet above the surface of the ground.

In a previous article in the SCIENTIFIC AMERICAN I described the type of cell and the peculiarities of my transformer. I wish to describe in this article some new results I have obtained with the greatly increased size of the battery.

The plant occupies a room in the laboratory approximately 30 by 60 feet. The battery is contained in closets with doors to protect from the dust. Fig. 1 gives a general view of these closets with the racks of cells.

Glass condensers serve the function of Leyden jars. There are twelve of these trays, carrying twenty-five glass plates each, there being thus three hundred plates in all. The condensers are made one-eighth of an inch in thickness, and they have a coated surface of tinfoil, 16 × 20 inches; the capacity of the entire condenser in multiple is about 1·8 microfarads. When the condensers are charged to twenty thousand volts and discharged in series a spark six and one-half feet in air is produced. As I have previously said, a longer spark cannot be produced as long as the apparatus is situated in a room and not in an open space.

I have lately made some interesting experiments in regard to the question, "Can lightning pass through a small orifice?" And I mention these experiments in this connection to illustrate the character and behavior of these powerful discharges. A plate of glass five feet square and one-quarter of an inch thick was placed between the spark terminals. The plate was necessarily of this size to prevent the sparks from passing around the edges of it. The plate had a small hole bored through it at its center. This orifice could be made much smaller by filling the hole with paraffine and making a needle hole in the paraffine. It was found that when the discharge terminals were in line with the hole and five feet apart the discharge would

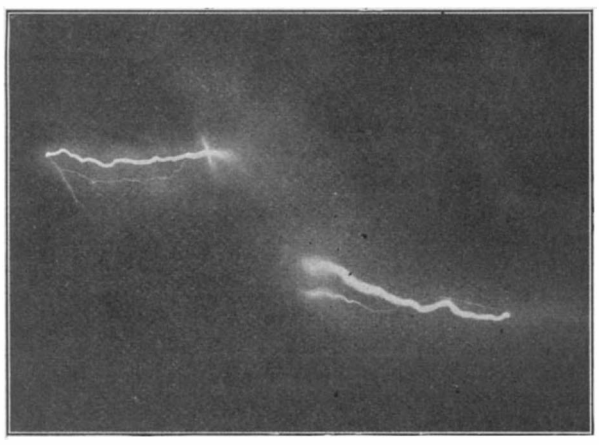


Fig. 2.—DISCHARGE AT HIGH POTENTIAL.

pass through the minutest orifice; but the portion which passed through the hole was only a fraction of the entire discharge, for there was an inductive action over the entire surface of the glass. This inductive action could be shown by hanging a large sheet of paper in front of the glass. After the discharge it was found closely adhering to the glass, while its presence did not modify the general appearance of the spark shown by the photograph; furthermore, when the hole in the plate is entirely closed by paraffine and the spark terminals are placed opposite each other, about four feet apart, with the glass plate midway between them, a spark will jump from one terminal to the surface of the glass, while no spark is seen on the opposite side of the glass. On close inspection, however, a faint brush discharge can be detected on the sparkless terminal; the discharge has been continued by an inductive action over the entire surface of the glass.

When the spark terminals were not opposite, the spark also sought the orifice, but in general the discharge jumped to the nearest point of the glass and then pursued a devious way to the hole. I was interested to study the electrical action at these forks or sinuosities, and accordingly hung up a large sheet of paraffined paper on the glass and photographed the discharge through the translucent paper. After the discharge the paper was found to be blown out in rents at points corresponding exactly to the forks or sinuosities of the discharge. I have arranged a photograph of the spark and a photograph of the rents in the paper near each other, and it will be seen how closely the explosions correspond to the forks. Is it not possible that the peculiar rolling of thunder coming apparently from a single discharge of lightning may be due to successive explosions along the same spark many hundred feet apart? The discharge of the condensers in multiple, however, has more scientific interest than the discharge in series, for by its means great heat can be generated in a confined space, giving probably the highest instantaneous temperature which has been attained. The following experiment illustrates the quantity of this discharge; a fine iron wire about six inches long was stretched around the spark gap serving as a shunt to the latter. It was found that the wire was deflagrated, Fig. 5, at the instant that a spark passed across the air gap. This leads me to think that a small spark could occur under certain conditions inside a metallic cage and in the case of very powerful lightning discharges a wire cage would not be a perfect protection for a powder magazine.

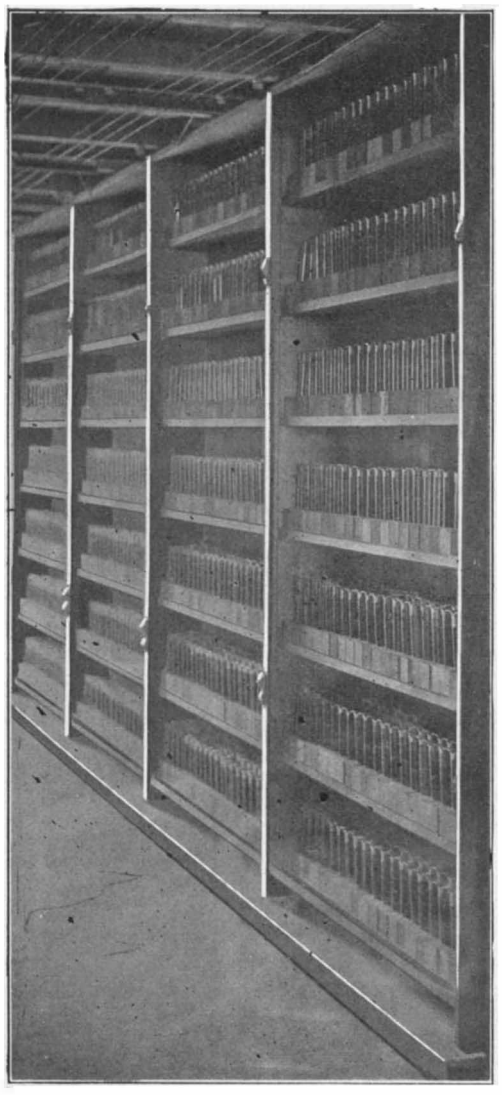
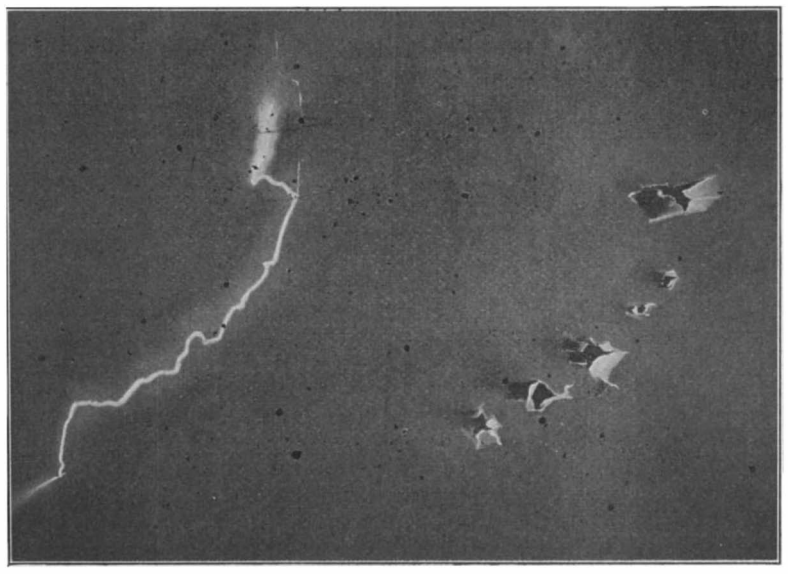


Fig. 1.—AISLE OF BATTERY.
24 × 6 feet; there are eight aisles in all.

I have used the strong current from the entire battery to excite discharges in hydrogen, for the spectroscopic study of this gas is of the highest interest, since it is apparently the chief constituent of the atmosphere of a great number of stars, and it is the constituent of the flames of the sun. From my spectroscopic study I find that aqueous vapor becomes manifest in all glass vessels which I have examined filled with apparently pure dry nitrogen or hydrogen. The powerful discharges drive off the aqueous vapor from the glass, notwithstanding the glass has been subjected to a long process of heating to expel the vapor during the exhaustion of the tubes.

The most interesting result, however, I have obtained with this great battery is the production of the X-rays for the first time by a steady current. An X-ray tube is simply connected to the terminals of the battery and a water resistance of perhaps a million ohms resistance is inserted in the circuit, the tube is then heated by an external source of heat. In an instant the tube lights with a most brilliant exhibition of X-rays, and photographs taken by means of them show unmistakable evidences of the tendons and muscles. I believe that when the right conditions are reached I shall obtain satisfactory photographs of these objects.



Spark. Explosion.

Figs. 3 and 4.—DISCHARGE THROUGH PARAFFINED PAPER.

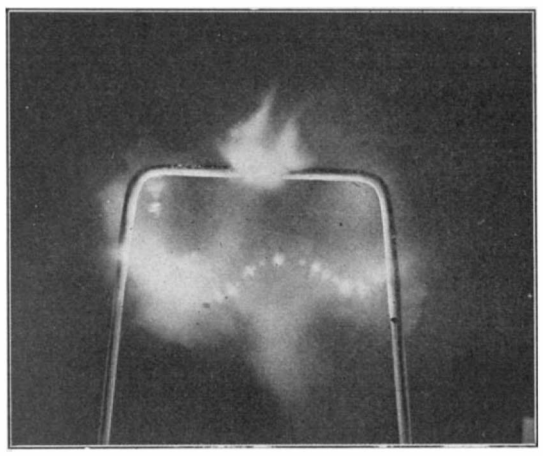


Fig. 5.—DEFLATION OF THE WIRE.

The Schweitzer System of Bread-Making in Paris.

There has recently been established in Paris a company for the formation in all the populous centers of France of combination milling and baking houses worked by machinery. The object is to furnish nutritious and digestible white bread at the lowest cost of production. The first establishment began operations in Paris on July 15. The bread is sold to the working class at about 2½ cents per pound, which is considerably less than the usual price. The Villette establishment is 515 feet long and is situated on a canal. The wheat arrives in boats, and it is then elevated into bins, whence it is carried by an enormous elevator to the top of the mill and turned into the different cleaning and separating machines. After all foreign substances have been removed and the grains of wheat have undergone a thorough brushing and washing, they are clean and shiny, but the grooves of the wheat sometimes contain a little dust which is entirely eliminated by a device which seizes each grain lengthwise, splitting it exactly in the groove. The wheat then passes into a mill composed of flat, circular grinders grooved in such a manner that they accomplish the decortication of the kernel, and its granulation into meal at the same time. The grinders are movable and do not touch, so that instead of crushing the grain and producing a flour, the starch only of which is retained, the outer and harder portion is retained in the flour, the bran only being expelled.

Attached to the mill are the works for kneading the meal, water and yeast into bread. All this is accomplished mechanically. Special yeast is prepared in the upper story, in rooms which are heated in winter and cooled in summer. The yeast, flour and salted water and filtered water are carried down by machinery into kneaders in the form of half cylindrical tubs rotated on two pivots placed close to the kneading troughs, so that the tubes may be placed at a lower or higher angle, in order to accelerate or retard the kneading. The wheat, salted water and yeast automatically enter one end of the tub, and the dough, in an endless skein of pale yellow, issues from the opposite end. The dough falls on tables on the ground floor, where it is weighed and made into bread of every shape and size. There is a laboratory in connection with the establishment for the chemical examination of the samples of wheat submitted.

FOR some time past workmen have been engaged in pulling down the mound on the north side of Cardiff Castle, and constructing a massive wall on the site of the Roman foundation, and now three-quarters of the northern rampart has been laid bare. The discoveries made tend to throw a great deal of fresh light upon the condition of Cardiff Castle in Roman times.

Paris Exposition Notes.

The Optical Palace contains the great telescope of 1900 which is the largest yet constructed. It is now in working order, and a number of observations and photographs have been made. It has been constructed by a company called the Société l'Optique ; the idea originated with M. François Deloncle, a former deputy and minister, and the work of construction has been carried out by M. Gautier; the enterprise owes no small share of its success to M. Gaston Laforcade, who is one of the directors. The objective has a diameter of 49·2 inches and weighs 1600 pounds ; the glass disk was cast at the Jeumont works, and eight disks were rejected before a perfect one was found. The tube of the telescope is nearly 200 feet long, being supported horizontally on iron arches, and the image of the star is sent into it by a siderostat whose mechanism revolves a mirror 78¾ inches in diameter and 9 inches thick. The eye-piece is mounted upon rollers and has a screw adjustment for focusing ; at the back is a frame which carries the ground glass to be used in photographic work. The view of the moon as seen on the ground glass is very striking, the image is 21 inches in diameter and is the largest yet obtained; the different details of the moon's surface are shown with great clearness ; when the mirror is stopped the image moves rapidly, and disappears in a few minutes. The building contains a hall of considerable size constructed with a view of making direct projections of the moon's disk upon a large screen. This has not as yet been carried out, owing to the fact that the conditions must be favorable, such as the condition of the weather, phases of the moon, etc. A number of fine photographs have been taken with the telescope, and these have been enlarged and are projected upon the screen, with striking effect. A number of eminent astronomers have made use of the great telescope in making observations, and it is likely to render a considerable service in astronomical work. It is understood that the company wish to dispose of the telescope to one of the large observatories after the Exposition.

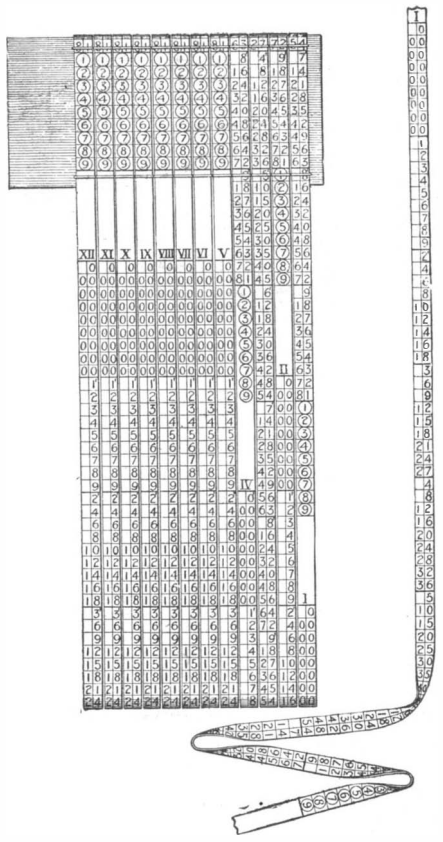
One of the interesting features of the Electrical Palace at the Paris Exposition is the centennial exhibit of historic apparatus installed by the French government. It is situated on the second floor, not far from the United States Pavilion. It occupies a considerable space, the smaller apparatus being placed on the shelves of a number of cases, while the larger pieces, dynamos, etc., occupy the central part. In the cases is shown a great variety of apparatus used by different inventors and early forms of instruments. An interesting collection of books is shown, dating from the seventeenth and eighteenth centuries, and relating to physics or electricity. The oldest of these is an example of Gilbert's famous Latin treatise on magnetism, "De Magnete," published in London in 1600. Among the works of the seventeenth century is a treatise on magnetism by Kircher, 1864, and a work by Otto von Guericke describing his vacuum experiment. It is dated 1672. Among the eighteenth century works the most important is a French translation of Franklin's works, bearing the title "Experiments and Observations on Electricity, made in Philadelphia by Benjamin Franklin, and contained in several letters to M. P. Collinson, of the Royal Society of London." It was published at Paris in 1752. Among the works of the present century are treatises on physics and electricity by Oersted, Becquerel, De la Rive, Arago, and others. That of Ohm bears the title, "The Galvanic Chain, by Dr. G. S. Ohm. Berlin, 1827." Among the most interesting of the apparatus in the cases may be mentioned a number of early forms of dial and needle telegraphs of the Breguet and other types, some of which were loaned by the Society of Postes and Telegraphes. The laboratory of the Sorbonne furnishes a galvanometer of the Nobili pattern, made by Ruhmkorff, with an electroscope. Two incandescent lamps of the Lodyguine type are shown, in which a carbon rod is used, surrounded by a glass globe with imperfect vacuum. One of these was made in Paris in 1874 by Komm, and the second by Fontaine in 1876. An original Clamond thermopile is also shown, this having been presented by the inventor to M. Jamin ; also a bismuth thermopile of Pouillet. A registering telegraph receiver using chemical paper is to be seen ; it was constructed by Pouget in 1852. An interesting collection of Jablockkoff candles is shown, besides a lamp globe containing eight candles mounted upon a base ; it is one of the series used in 1876 for the lighting of the Avenue de l'Opera. Among the larger apparatus may be mentioned an old type of frictional machine of Van Marum with disk, and another of the cylinder type of Naime. A magneto machine constructed by Pixii, under the direction of Ampère, is to be seen ; this has been loaned by the Sorbonne. A number of early types of dynamos are shown, among which is a dynamo for electro-chemical work, claimed to be the first used for this purpose ; it was installed at the Christofle works at Paris in 1872. Several early types of gramme dynamos are also to be seen. The collection, which is not yet completed, will be of great interest.

AN INGENIOUS CALCULATOR.

A calculator remarkable for its simplicity and ingenuity and decidedly different from other machines which employ a series of tapes has been patented by Chow Ling Shang, of 57 Holanyen Street, Macao, China. The device considerably simplifies multiplication and division. Our illustrations show the complete apparatus and one of the tapes employed.

Upon a base of wood or other material guides are secured which form passages for a series of endless tapes. In our illustration the tapes are designated by the Roman numerals I, II, III, IV, etc. Each tape is longitudinally divided into two columns and into groups of nine numerals each. In the first group all the figures are zeroes ; in the second group the numbers "1" to "9" are inscribed ; in the third group the number "2" and its multiples up to "18" are written, the units being in the right hand column and the tens in the left hand column. In the next groups are the multiples of 3, 4, etc., up to the multiples of 9, after which the numbers 1 to 9 appear in the center of the tape, the division of the tape into two columns being abandoned at that point.

When it is desired, for example, to find the product of eight times eight thousand four hundred and ninety-seven, the tapes I, II, III, IV are moved until the numbers "8," "4," "9," "7" of the tapes are on the same horizontal line, the other tapes being left in their normal positions. In the eighth line will be found the number "56" on tape I; in the same line, tape II bears the number "72"; tape III the number "32"; and tape IV the number "64." The product is obtained by noting for each tape the number contained in



A SIMPLE CALCULATOR.

the right hand column of that tape, with the addition of the number in the left hand column of the next tape to the right. In other words, contiguous numbers of different tapes are added. Thus, in the present case, "2" and "5" from tapes I and II are added, "2" and "7" from tapes II and III, and "4" and "3" from tapes III and IV. The result obtained is "67,976," which is the product sought. The figuring of other products is readily understood from this example. To multiply by a number larger than 10, the well-known method of adding the results of partial multiplications is employed.

In division the calculator is employed to find multiples of the divisor and to do away with tedius multiplication. In dividing 212,425 by 8,497, for instance, 21,242 is divided by 8,497, as usual, giving 2 as the first figure in the quotient ; the calculator may be used for this operation, since it shows that 21 (in the thousands) is between the double (16,994) and the triple (25,491) of 8,497. Twice 8,497 is then read off as 16,994 and subtracted from 21,242, leaving 4,248. To this remainder is added the last figure, 5 ; and 42,485 is then divided by 8,497. The machine shows at a glance that 42,485 is equal to 5 × 8,497. The result of the division is therefore 25.

A Telescope Discovers a Theft.

A telescope was recently being tested at the Bausch & Lomb Optical Works, at Rochester, N. Y., and it was turned on a bridge and the observer saw a young thief take a tub of butter from a wagon and conceal it. The police were telephoned to and the thief was captured as he was attempting to carry away his prize a few hours later. This is an interesting use of the telescope.

Science Notes.

A large mushroom has been gathered at Newton, in South Lincolnshire. It measured 38½ inches in circumference and weighed 2¼ pounds.

To accelerate as much as possible the export of Siberian agricultural produce to England, the Russian Minister of Commerce has arranged for a special series of fast trains to convey the produce from Irkutsk to Riga.

The revolt in China has had a serious effect upon ginseng diggers in various parts of the country, particularly West Virginia, where many of the inhabitants of the mountainous districts gain a livelihood by digging out ginseng roots from cliffs and obscure nooks and corners of the dense forests. The price has dropped more than half.

Prof. W. Ceraski, of Moscow, announces in the Astronomische Nachrichten that Mme. Ceraski has found a new variable star on examination of plates taken by M. Blajko. The star has the following position :

Right Ascension, 0 h. 28 m.
Declination + 79° 33′.

The brightness varies from between 8 and 9 to about 12 magnitude. It was increasing in October, 1896, and decreasing in October, 1897, being almost at a minimum during May, 1898, April, 1899, and at the commencement of May, 1900.

The new physical laboratory at Owens College, Manchester, has been recently opened ; it has a larger floor area than any other similar institution in the world, with the exception of the Johns Hopkins and the Strasburg laboratories. Great efforts have been made to provide an equipment of the most modern apparatus for use in every branch of physical science, and to maintain conditions which shall ensure their being used to the best advantage. The research laboratories are to be an important feature of the new buildings, and should attract a large number of students. Another feature is the electro-technical wing, which is to constitute a John Hopkinson memorial ; it is understood that Dr. C. H. Lees, formerly chief assistant lecturer in the physics department of Owens College, will occupy the post of assistant director in the new laboratories, under Prof. A. Schuster, the director, and that Mr. R. Beattie has been appointed lecturer in electrotechnics.

Some notes on the New Zealand volcanoes are contributed to the latest volume of Transactions and Proceedings of the New Zealand Institute, by Dr. B. Friedländer. A description of an eruption of Le Mari witnessed by him is of interest ; the eruption began with an explosion, and masses of ash-bearing steam were ejected. There were at least four different phenomena. 1. The reflection of incandescent matter upon the dark clouds. 2. A large number of red-hot bowlders, which were shot up and fell down in parabolic curves. 3. Lightning, due to electricity produced by friction, the lightning appearing in the masess of ash-bearing steam, the ashes of which were coarse, the grains being about the size of a pin's head. 4. Blue flames, and probably reddish flames. Dr. Friedländer suggests, to account for the flames, that during the explosion there escaped combustible gases which at a certain height above the crater met the oxygen necessary for taking fire. He considers that the phenomena are due rather to vaporized sulphur than to hydrogen, the flame of the latter being less brilliant and less distinctly blue.

Writing in the Physikalische Zeitschrift, Herr R. E. Liesegang describes a mixture of sodium carbonate and hydroquinone which takes a deep blue tint on exposure to the air, and this blue color is rapidly destroyed by radiant heat. Equal parts of hydroquinone and anhydrous sodium carbonate in fine powder are stirred up with a small quantity of alcohol, so that the mixture can just be spread ; and this mixture rapidly acquires a deep blue color. Some of the above-mentioned mixture was spread on thin writing paper, after which all excess was brushed off, when the blue compound was formed in the substance of the paper. So sensitive to heat radiations did this paper prove that when it was exposed to the radiations from a gas stove for five seconds the blue color was bleached, and by interposing such an object as a coin, a definite cutting off of the heat rays could be effected, and, of course, a thermograph was formed on the paper. Ordinary black paper, on the other hand, has but little effect in stopping the radiations ; a wrapping of such paper only necessitating an additional exposure of a few seconds. The sensitive blue substance is assumed by Herr Liesegang to be an intermediate oxydation product of hydroquinone, but if moistened with alcohol or water, it is slowly destroyed. It may be mentioned incidentally that some forty years ago Hesse described the formation of a deep blue compound when quinone in a moistened state is brought into contact with caustic potash or lime, but we are not aware of any recent work being done in the way of following up Hesse's observation ; still, it may now be a matter of considerable interest to isolate Hesse's blue compound.

FIREPROOFING WOOD.

(Continued from first page.)

cess, it is of such dimensions that it is capable of treating full size specimens on a commercial scale and has been for some time in continuous daily operation. It consists of a charging tank, a receiver 18 inches in diameter and eleven feet long, and the boiler, pressure and circulation pumps, and accumulator necessary for operation. In all the existing methods of fireproofing wood the principal element is the receiver, which usually is built up of a certain number of lengths of massive cast or wrought iron pipe, and closed at one or both ends by gates which are made extremely heavy to enable them to withstand the heavy hydraulic pressure that is necessary in the process. Owing to the large diameter of the pipe the accumulated pressure on these gates amounts to a great many tons, and extreme difficulty has been experienced, even with the lower pressures that are used in other processes, in preventing leakage. The doors are usually closed by a system of multiple-locking devices, and considerable time is taken in closing them and securing a water-tight joint. Difficulties that were considerable when pressures of 120 pounds to 170 pounds to the square inch were used, would have become insuperable in Mr. Ferrell's process, where pressures of from 200 pounds to 750 pounds to the square inch are ordinarily used, and where, in the treatment of some of the hard woods, it may be necessary to run the pressure up to 1,500 pounds to the square inch. Realizing that the hinged gate would be impracticable, it was decided to make use of a gate inserted within the pipe a few feet from its outer end, and the form of gate shown in the accompanying illustration of the one-cylinder plant which is now being constructed at Long Island City was adopted. Near the end of the receiver is bolted a massive gate housing, which consists of a cast iron chamber with a dome cover bolted upon it. Within this chamber the gate moves vertically, with a slight clearance, between vertical guides, its stem passing through a stuffing box in the top of the dome and carrying a small piston which works within the vertical hydraulic cylinder shown above the dome. When the gate is closed its outer face is in close contact with a seating of phosphor bronze. When the liquor is pumped in and the hydraulic pressure accumulates within the receiver, this pressure, it will be seen, forces the gate into closer contact with its seating, any increase in pressure tending to secure a tighter joint.

In the plant which we inspected at Philadelphia, the opening or closing of the gate is accomplished in from five to seven seconds, and it was noticeable that under a pressure of 400 pounds to the square inch the joint was perfectly tight. The wood to be treated is placed within the receiver, the gate is closed, and the fireproofing liquor is allowed to fill the receiver by gravity, flowing into it from the filling tanks. As soon as the receiver is full, the pressure is increased by a Worthington high-pressure pump, the discharge pipe of which is connected to an accumulating cylinder that serves to cushion the shock of the pumps and prevent the wood under treatment from being bruised or otherwise damaged by the impact of the inflowing liquor. This accumulator was found to be an absolutely essential feature in the process, for Mr. Ferrell informs us that when pumping under pressures approaching 1,000 pounds to the square inch, without the accumulator the shock of the pump was sufficient, at times, to bruise the wood and even to split it asunder. The pressure in the receiver is allowed to rise to the predetermined point at which the saturation of the wood is to be accomplished. In the case that came under our personal notice, two planks of white pine, each measuring 1 inch by 8 inches by 13 feet, were placed in the receiver, and after the pressure had been run up to 400 pounds to the square inch, they were subjected to treatment for exactly ten minutes. The liquor commenced to penetrate the pores of the wood as soon as the pressure reached this point, and as it entered the supply of liquor was replenished by the action of the pumps. The extraordinary amount of injection that was taking place was shown by the sudden drop of the accumulator when the liquor first forced its way into the wood. After ten minutes' treatment the pressure valve was closed, and the liquor remaining in the receiver was pumped back into the tank. The receiver gate was then opened and the treated wood removed. The wood before its admission to the receiver weighed just 35½ pounds dry. On being withdrawn from the receiver, it was again placed on the scale and showed a weight of 69¾ pounds, making an absorption of practically 100 per cent in ten minutes.

After the wood has been treated, it is kiln-dried, the moisture being evaporated and the salts deposited upon the walls of the cellular structure of the wood in the form of extremely fine salt crystals. When the kiln-drying is completed, the gain in the weight of the wood will be from 5 to 10 per cent, according to the treatment and the quality of the wood itself. The high pressures under which the saturation is carried out, render it possible to secure saturation to the very heart of the wood, even when large sizes, up to 12 by 12, are being treated. This is, of course, an important feature, and, contrary to what might be expected, the enormously high pressures to which the wood is subjected do not appear to injure in any way its physical properties. Indeed, as a matter of fact, the laboratory tests show that the compressive and bending strength of treated wood is appreciably increased, while treatment does not in any way impair the ability of the wood to properly take paint, varnish, or polish, the specimens that were submitted retaining the native color of the wood and the varnished surfaces being fully equal to those of untreated specimens. The fireproofed wood is no harder to work with tools, although, as might be expected, the tools require more frequent sharpening.

The fireproofing liquor is non-corrosive, it is not volatile, and it is not hygroscopic; once the salts are distributed throughout the body of the wood and deposited on the walls of the cells they are, as far as exhaustive tests would indicate, indestructible and not removable. Specimens have been immersed for months in water, and exposed to the weather without losing their fireproof qualities.

The large plant which is illustrated on the first page of this issue is now being erected at 401 Vernon Avenue, Long Island City. The receiver, in this case, is 50 inches in diameter and 116 feet in length. It is built up of cast steel cylinders, whose walls are 2 inches in thickness. The cylinder bolts are 3 inches in diameter and the bolts fastening the dome to the receiver are 3¼ inches in diameter. At the far end of the building is seen the pump for feeding the receiver, the liquor being delivered against the pressure of an accumulator. At the center of the building stands a centrifugal pump that is utilized for returning the liquor from the receiver to the tank, while in front of it is a small Worthington pressure pump that is used for operating the lifting cylinder that raises the gate. This new plant will have a capacity for treating 15,000,000 cubic feet of lumber per annum.

With regard to the cost of fireproofing, we have before us the figures for some structures in which fireproof wood has been used exclusively. In the case of a framed cottage at Sea Isle, whose total cost was $3,000, the cost of the wood $645, and the cost of fireproofing the same wood $1,050, making the cost of fireproofing 35 per cent of the total cost of the house. In the case of a colonial stone house at Germantown, which cost $14,000, the cost of fireproofing represented 18 per cent of the total cost; while the fireproofing of the wood in a nine-story office building, whose total cost was $400,000, was only 1·7 per cent of that amount.

A few simple experiments with the blowpipe suffice to prove beyond question the absolutely fireproof qualities resulting from this process. If a bunch of shavings of fireproofed wood are exposed to the flame of a Bunsen burner for ten or fifteen minutes it is found that, while they are charred, they have not crumbled away, and that while the Bunsen flame will make a piece of treated wood glow to a cherry red, the instant the flame is removed the glow is extinguished under the action of the ammonia fumes from the salts. Shavings and sawdust of fireproofed wood may be soaked in benzine and ignited. The benzine will burn away, leaving the substance of the wood practically untouched. In fact, one might as well attempt to burn a bundle of asbestos as to burn a bundle of these fireproofed shavings.

We present a series of illustrations of a remarkable test made on two small wooden buildings, which was carried out at the shipyard of the New York Shipbuilding Company, Camden, N. J. The two structures were identical in size and construction, one, however, being built of untreated wood and the other of wood fireproofed on the system above described. A considerable pile of resinous pitch pine was built around each structure and ignited. The progress of the fire is shown in the illustrations. It is sufficient to say that at the end of 16 minutes the untreated building was in ashes and the fireproof structure was practically uninjured. The fire was allowed to burn for 18 minutes more under the remaining structure, and it was then put out by means of a chemical engine. The door was opened and a box made of 1½-inch treated wood, and measuring 12 inches by 20 inches by 12 inches in depth, was placed in the middle of the floor. It was filled with a number of pamphlets and manuscripts, and the cover was screwed securely down. Sticks of pitch pine were then piled over it and the whole saturated with oil and ignited. At the end of 23 minutes' time the box was pulled out and opened, and the contents were found to be not even scorched. The wood of the box was charred only to a depth of about ⅛ of an inch, while the experimental house itself was not only intact but was very little charred. These tests confirm the thorough nature of this system of fireproofing as demonstrated by the smaller tests of the laboratory.

THE telectroscope of Szczepanik is not in evidence at the Paris Exposition, which is not a very great surprise, as his plan was regarded as visionary by physicists.

Electrical Notes.

The Baltimore and Ohio Railroad Company has decided to install the third rail system in their tunnel at Baltimore.

Electric cars operated by storage batteries will be used on the Thirty-fourth Street cross-town line of the Metropolitan Street Railway Company, of New York city. There are few cities in America where horse cars are still in use, but there are fifteen such lines in New York city.

A project has been formed to construct an underground system of electric railways in Berlin; for this two different routes are proposed: the first is to prolong into the city the Siemens & Halske lines, and the second favors a complete independent system; the latter project is the most likely to be carried out, as it will require the construction of underground lines, assuring the greatest speed with a maximum security. The proposed system consists mainly of a circular line, which will unite the principal railroad stations, two lines going north and south and connecting with a third line in the southern part of the city, and two lines extending east and west.

A few days ago Mr. Algernon H. Binyon read a paper on "Electric Traction" before the Society of Engineers in London. He said that no less that 309,000,000 passengers were carried by the tramways of London every year; the omnibuses conveyed 248,000,000; and the underground railway, 128,400,000. By this it will be seen that the tramways were the most favored means of transit, since they carried no less than 45 per cent of the total traffic. With reference to the introduction of electric traction in connection with the London tramways, he contended that the overhead system, such as was employed in the majority of the English towns, was the most efficient and economical. He specially favored the side trolley system, since that form dispensed with the unsightly necessity of long brackets. In combining lighting and tramway plant he suggested the employment of separate mains and dynamos. He also remarked that it would be a decided advantage if the cars were equipped with meters, since by this means it would be possible to reduce the amount of waste, through careless handling of the controllers by the drivers, by 30 per cent.

The transatlantic liner "Oceanic" furnishes a remarkable example of the application of electricity in modern steamships. There are two separate dynamo rooms, each forming a water-tight compartment that can be isolated in case of accident. Each plant contains two double cylinder engines, each of which drives directly a 100 horse power dynamo at 240 revolutions; each dynamo can supply 1,000 lamps of 16-candle power. Two switchboards are provided, one in each room, and these are arranged so that the dynamos may work separately or in parallel. The installation feeds 1,975 lamps, including the signal lights; these latter are provided with an automatic device by which, when a lamp is broken, another is placed in the circuit; at the same time an alarm is given. A complete system of electric heaters is provided, these taking the form of radiators placed in nearly all the cabins; they consume about 1½ horse power each, and will give three different temperatures. The ventilating system is also very complete; four large ventilators are driven by electric motors. In the kitchen an electric heating and cooking apparatus has been installed, and electric bells are used in great number, as many as 1,130 in all; these are arranged to give a single stroke during the day and a vibrating stroke at night. There are also 15 different annunciator and indicating boards. The fog-sirens are worked by a relay magnet and clock movement, by which they are blown for several seconds at regular intervals.

The Metropolitan Underground Railway of London is making a number of experiments with a view of substituting electric traction for the present system of steam locomotives. The tests are being carried on under the supervision of a committee of experts, among whom Sir William Preece occupies a prominent place. The train used in the trials is made up of six electric cars weighing 180 tons each; the cars are provided with an eight-wheeled truck at each end, carrying four motors, the total weight of each truck being 54 tons. The motors have a capacity of 200 horse power each, or 800 for each truck, but in starting they will develop 950 horse power with a load of 970 tons on a 2·3 per cent grade. The wheels have a diameter of 45 inches and the train is 225 feet long. By using the electric system the speed of the trains may be increased from 11 to 15 miles an hour and the frequency of the trains by at least 30 per cent. The stations on this line occur at short intervals, and the stops are of such frequent occurrence that the trains are not able to keep a uniform speed, but are continually starting and slowing. Under these conditions the electric system is far superior, as it permits the train to start quickly and to stop within a short distance. In the tests recently made the new train reached a speed of 20 miles an hour within a distance of 180 feet, and when running at this speed came to a stop within 120 feet, or about one-half its length.

A YACHT THAT SAILS ITSELF.

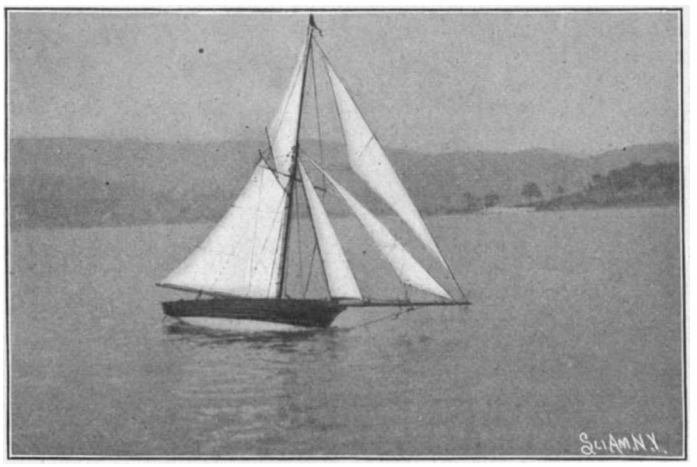
It is the ambition of every builder of sail boats, whether his craft be a diminutive model 2 or 3 feet long, or a giant "ninety-footer" like the "Columbia" or "Shamrock," to produce a vessel that will "point" well and "foot" fast at the same time. Almost anything from a wash tub to the proverbial "haystack," will sail before the wind; but it is when the yachts tighten in their sheets and lay their course to the weather mark that the genius of the yacht builder begins to reveal itself. Unless the wind is blowing in a direction that makes an angle of four or five points with the course, the yacht has to be sailed with the wind alternately on the port or starboard bow. In a full sized yacht the work of putting the vessel about from port to starboard and starboard to port involves the constant shifting of the helm and retrimming of the sails—work which is performed by the crew on board.

The accompanying illustrations of the little model yacht "Nydia" represent a very ingenious and successful attempt to produce a sailing craft capable of going through all the maneuvers of beating, reaching and running automatically, the helm being put up or down, and the sails sheeted in or slacked off with the precision and regularity which marks the handling of a yacht by an expert crew. The "Nydia" was built and her complicated steering and sail handling mechanism was designed by Mr. H. Consterdine, of Lancaster, England, to whom we are indebted for the accompanying photographs. The various operations involved in putting the helm down and changing the trim of the sails are performed by the joint agency of the wind pressure on the sails, a log which trails in the water astern of the ship, and a set of cogwheels, pulleys and shafts which are carried on the deck. The yacht may be started from a lee shore, and made to perform any desired number of tacks against the wind, at the conclusion of which she will swing around, the main boom will be squared off, and she will return before the wind to the starting point, all these operations being performed without any outside assistance. Moreover, the length of the alternate tacks may be varied by a proper adjustment of the mechanism and, if so desired, the boat may be made to sail on alternate long and short tacks.

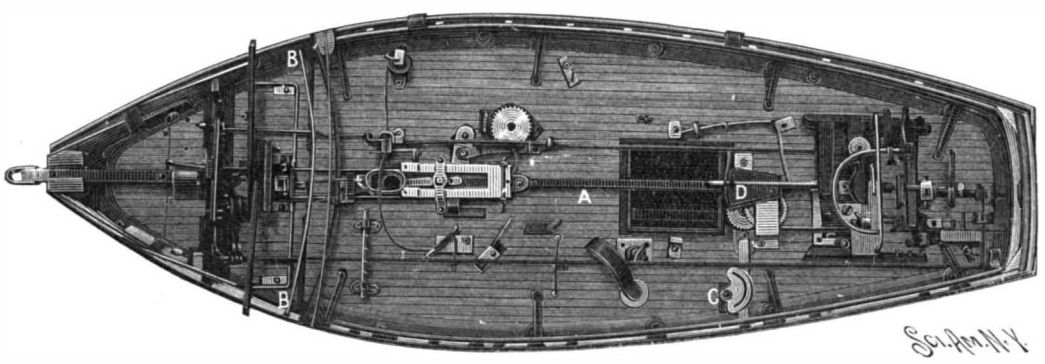
The source of power for working the sail and tiller mechanism is the wind, while the trailing log is used for regulating the length of each tack and the time of making the turn at the outer mark. We will suppose that the vessel is started on the starboard tack. The revolutions of the log give motion to a latch or stop-piece, which is in engagement with the tiller. After the proper number of revolutions, the tiller, *D*, is automatically disconnected from the stop-piece when, owing to the fact that the main sheet is belayed to the tiller stanchion, the strain of the sheet will bring over the tiller and cause the helm to be put down, bringing the little vessel around on to the port tack. Running fore and aft on the deck is a connecting-rod, *A*, the after end of which is attached to a little pin carried on the tiller. The movement of the tiller as it is swung to port or starboard thus serves to give the connecting rod a longitudinal movement, which, in its turn, manipulates the foresail and jib as explained before.

The foresail sheet is attached to a little block that slides on an athwartship rail, *B*, which is struck to a curve whose radius is about equal to the length of the foot of the foresail. At the forward end of the connecting rod, *A*, just referred to, is a sliding pin, which releases the foresail sheet sliding block when the helm is put down, and so slacks away the foresail. The connecting rod also serves by its longitudinal movement to let go the jib sheet. Instead of having a jib sheet block sliding on a rail, as in the case of the foresail, the jib is provided with a pivoted boom, which engages with a releasing and holding-fast gear actuated by the connecting rod. The foresail is trimmed to windward by its foot boom engaging with a locking and releasing holder, operated by the fore and aft movement of the connecting rod, and its release takes place when the wind carries the mainsail over to the lee side at the commencement of a fresh tack. The length of each tack is regulated by the set of the blades on the log, which can be altered at will, and also by an intercepting gear between the primary motion shaft and the tiller releasing-gear. The proportionate length of one tack to the other is determined by the relative working positions of the tiller-releaser, and the tiller-engaging peg. These relative positions are adjusted by means of an eccentrically slotted quadrant, *C*, which acts through a lever that serves to hold the releaser.

If it is desired to have the yacht return before the wind to the starting point after beating to the outer mark, it is only necessary to allow a catch or pawl, which is worked by the rotation of the log, to engage with the teeth of a registering wheel, the rotation of which brings a small peg on this wheel into contact with the main sheet holder after the yacht has covered the required distance. The main sheet being released, immediately pays out, and the little yacht swings around for her homeward journey before the wind. The main sheet runs within a tube on the boom and through the holder, and is then stowed away on a reel which unwinds as the wind squares out the mainsail. The yacht is kept before the wind by the co-



THE "NYDIA" CHANGING TACKS—FORWARD SHEETS SLACKED OFF AND HELM DOWN.

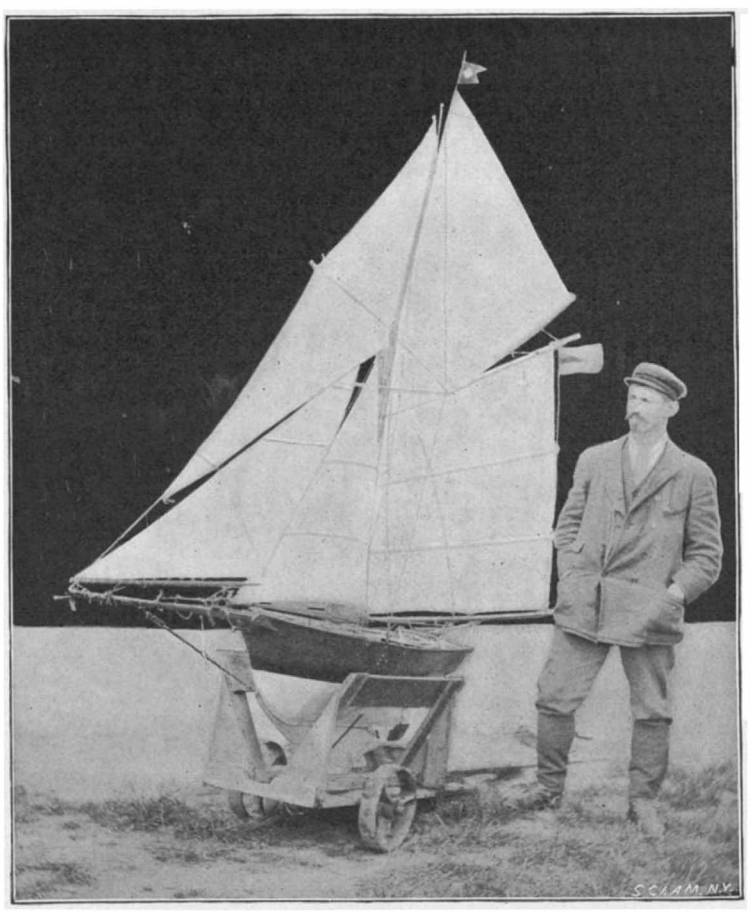


DECK VIEW OF THE "NYDIA," SHOWING THE MECHANISM FOR AUTOMATICALLY WORKING THE SAILS AND RUDDER.

operation of the foresail with the steering apparatus, the foresail serving to keep the tiller in a fore and aft or central position. As long as the foresail is shaking, well and good, the little yacht is dead before the wind; but if the pressure of the wind on the mainsail turns the boat slightly to port or starboard, so as to cause the wind to press on one side of the foresail, this pressure throws a set of wheels into gear, which wind up on a small chain attached to the tiller, and operate the rudder so as to bring the little craft again dead before the wind, when the wheels immediately become disengaged and the helm is eased. The revolution of the little log, which trails astern merely serves to regulate the engagement and disengagement mechanisms by which the vessel is put about at the end of its tacks, or turned at the outer mark for the run home before the wind. The log also serves to turn the motor shaft, which has been mentioned several times in the above description as assisting in the automatic control of the vessel.

Mr. Consterdine, who is certainly deserving of great credit for his ingenuity and mechanical skill, speaks enthusiastically of the working of his model craft.

If any of our readers who are enthusiasts in model yachting wish for further particulars of the "Nydia," they can secure them by communicating with Mr. H. Consterdine, at Milton House, Littleborough, Lancashire England.



THE SELF-SAILING YACHT "NYDIA" AND HER DESIGNER.

Tile Maps.

In the issue of the SCIENTIFIC AMERICAN for June 2 mention was made of a tile map for railway stations which is being introduced in England by the Northeastern Railway Company. The map is made up of 6-inch tiles and measures about 6 feet square. We have now received further details of this map, which it seems is the first railway map of the kind produced in England, and seems to have been so thoroughly successful as to warrant the expectation that this form of map will have a very useful future, not merely for railway work, but in other fields, among which may be mentioned particularly that of education.

In manufacturing the maps the tiles are made by the ordinary process of mixing various kinds of clay in liquid form. After the necessary treatment the tiles are moulded, placed in the kiln and brought to the condition technically known as "bisque." The drawing of the map is reproduced on copper plates, one plate for each tile, and impressions are made upon specially prepared paper. The prints so prepared are transferred to the surface of the bisque tile, and rubbed into it carefully, to cause the oily ink of the paper impression to adhere to the tile. The paper is then removed by dampening it with water and rubbing it off, the ink being left behind without any danger of injuring the surface of the tile or blurring the fineness or the sharpness of the lines. The tiles are then sent to the kiln to be "hardened on," after which they are put in kilns and fired. They are then taken to the painting room, where the colors are put on by hand, after which they are sent to the enameling kilns. After this third firing they are ready for "slabbing," as the cementing of a design or pattern in tile work is called.

The matter has been brought to our attention by Dr. J. W. Redway, F.R.G.S., who is of the opinion that these tile maps will be eminently suited for scholastic purposes, on account of their durability and the readiness with which they may be permanently placed on the walls of a school or lecture room. He points out that, unlike maps of the common type, they may be freely touched with the "pointer" without any fear of destroying their hard, smooth surface, a feature which should render them particularly valuable for school purposes.

Aerial Telegraphy from Balloons.

A series of experiments has recently been carried out in France by Messrs. Vallot, Jean and Louis Lecarme to determine whether aerial telegraphy can be carried out between the earth and a balloon which floats freely and without earth connections. The ascent was made by M. Vallot, who took the receiving apparatus in the balloon, the transmitter resting on the ground. The experiments seem to demonstrate that the earth wire is not indispensable for transmission under these circumstances, as when the balloon was elevated at a great height the signals were received clearly, even though the two masts were pointing in the same direction. The experiments also show that the difference of potential between the two posts does not appear to influence the reception of the signals, thus confirming the previous experiments in this direction made on Mount Blanc.

A BRITISH School of Archæology is to be opened at Rome. One of the most active promoters of the enterprise is Prof. Charles Waldstein. Prof. Rushworth has been selected as the permanent head of the school.

LOCOMOBILE WRINKLES.

One of the artists of the SCIENTIFIC AMERICAN recently purchased a locomobile, and as the result of three or four months' experience in night riding, he has devised a few "wrinkles" which are herewith illustrated for the benefit of our readers.

It is absolutely necessary for the driver to keep a close watch upon the water-glass, for although the fall of the water below the proper level does not by any means involve the destruction of the sturdy little boiler used on these machines, it certainly does not lengthen its term of life. The water-glass is located at the side of the driver and to avoid the necessity of his bending over to look at it, the builders place a small mirror on the dashboard, in which the glass is reflected. While the image is clear by day, it is apt to be a little vague at night, and it occurred to our artist that by the use of a powerful, concave mirror, placed in front of and just above the carriage lamp, a strong ray of light would be thrown upon the water-glass and a brighter image reflected on the dashboard mirror. He used a 2½-inch concave mirror, which was attached to the lamp, in the position shown in the accompanying engraving; the result has been very satisfactory.

It is equally important that the driver should be able to read clearly at night both the steam and naphtha gages, which are carried on either side of the footboard. To render the gages more conspicuous, the white enamel face and black pointer were removed and a black face with white figures and a white pointer, made very much broader and heavier than usual, were substituted. At the same time the carriage lamps were extended laterally from the car to allow their rays to fall more fully upon the gages. The quick reading of the gages was further facilitated by making the pointers with a short steel tail, the balancing of the pointer being secured by weighting the tail with a drop of solder. These changes, like the introduction of the mirror, have proved very successful, and the driver can now watch the water level, the steam pressure, and the pressure in the naphtha tank, without his attention being diverted from his look-out duties as driver.

ILLUMINATING THE WATER-GLASS AND PRESSURE-GAGES OF THE LOCOMOBILE.

TYPES OF AMERICAN INDIAN BASKETRY.

BY OTIS T. MASON, CURATOR OF THE DIVISION OF ETHNOLOGY IN THE UNITED STATES NATIONAL MUSEUM.

At last, after an almost fatal neglect, patrons of savage American fine art are beginning to appreciate Indian basketwork. It is the only aboriginal art that has not been counterfeited; at the same time, it is more ideal than pottery, since form, technique, and intricate patterns must all be fixed in the imagination before the maker takes the first step.

TWINED BASKETRY.—In this paper attention will be confined to a single class or genus of basket technique, which I have elsewhere called "twined basketry" (Smithsonian Rep., 1883–1884, pt. II., 291,306). There are two genera of basketry:

1. Hand plaited, or woven, on straight foundation.
2. Sewed or wrapped, on coiled foundation.

Woven basketry is in (1) checker, as in the bottoms of common splint baskets of rectangular outline; (2) diagonal, or twilled, as in matting, all about the Gulf of Mexico, and in South America; (3) wickerwork, as in the Algonquian and Iroquoian ware; and (4) twined, or wattled, as will be now explained. Twined basketry has a warp of shoots, prepared stems (called osiers, or splints, arranged radially at the bottom and in more or less parallel fashion on the body. In this respect it resembles wicker work. The weft or filling may be with grass, split stems, or split roots; though, in coarser examples, vines and stems with the bark on are often used.

The weft elements are commonly administered in pairs, though in three-ply twining and in braid twining the three weft elements are employed. According to the relation of these weft elements to each other and to the warp, different types of structures result, which may be named as follows:

1. Plain twined weaving.
2. Diagonal twined weaving, or twill.
3. Wrapped twined weaving.
4. Lattice twined weaving, tee, or Hudson stitch.
5. Three-ply twined weaving.

In every one of these, except number 5, the wefts make a half turn or twine at each space between the warps, as may be seen on modern waste-paper baskets. This twined weaving has had a wide distribution in time and space. At present it is found among the Aleuts, the Alaskan Eskimo, and the Pacific slope tribes down to the Pueblo country, where it suddenly ceases and is seen no more in America. The ancient mound-builders practice it and so did the Lake Dwellers of Switzerland. Some of the African negro tribes also make twined basketry. To each one of the types named a fascinating variety is given by changing the form and administration of the warps; by using stems, splints, filaments or straws for the weft; by varying the distances in warp and weft, by using different colored woods or dyed materials, and by a sort of overlaying or embroidery, which consists in wrapping the warp elements on the outside with colored straws. Shell beads and other pretty materials are also sewed on the surface. The pictures in the text will make plain the five styles of twining. Figs. 1 and 2 are of a Pomo basket received at the National Museum some years ago from Dr. J. W. Hudson, of Ukiah, California.

The ornamentation on the surface, it is said, represents a trail through the mountains. Several types of twining co-exist on this specimen.

PLAIN TWINED WEAVING.—Figs. 3 and 4, in the two rows at the top, show plain twined weaving as it appears both on the inside and the outside. The next three rows are practically the same, only the interstices enclose two warps instead of one, producing an ornamental band. Inside and outside are alike, as in all plain twined ware. Excellent examples of this are the Aleutian wallets, made of wild rye; Haida hats, of spruce root, and many Pomo examples of willow, carex roots, and circes stems.

DIAGONAL TWINED WEAVING.—This type is produced by carrying the wefts over two warps or more, and on the next round alternating the warp enclosed. The technique is shown on the lower half of Fig. 3 for the outside, and on the lower right hand corner of Fig. 4 for the inside. Enlarged illustrations of this twining appear on the left hand side of Fig. 5 and the right hand side of Fig. 6. Good examples of this are to be seen on Haida and Thlinkit basketry, on basket bottles of the desert region of the West, but it blooms out in the Pomo ware, under the name of chuset.

WRAPPED TWINED WEAVING.—I have elsewhere given this the title bird-cage twine, because, as in old fashioned wire cages, the warp forms a lattice work with one of the wefts laid horizontally across the inside, making rectangular interstices, and the other warp is wrapped about the intersections. The technique is well explained by figures 4, 5 and 6. This type of twined weaving is not widespread, being confined on the Pacific Coast between the 30th and 50th parallel. It is seen in Makah, Quinault and Chehatis baskets, in Wasco Sally bags, and, in all its glory, in Hudson's Pomo, under the name of lit. It lends itself most kindly to difficult patterns.

TEE TWINED WEAVING.—This style of twined basketry is confined to the Pomo, of Russian River, California, and should be named after the discoverer of the Hudson type. There are, in fact, two warps and two wefts. The warp consists of vertical stems, as in plain twine, overlaid on the outside by a horizontal stem forming square interstices.

Fig. 2.—Bottom of Basket.

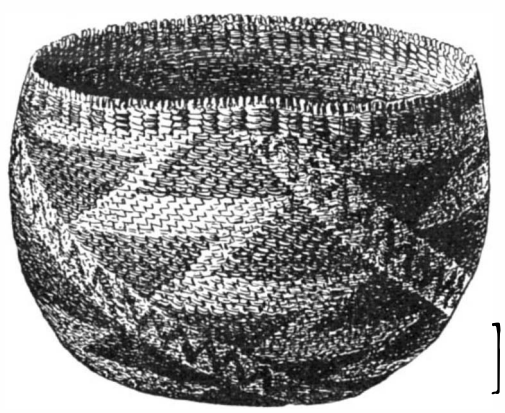


Fig. 1.—Pomo Indian Basket, Russian River, Cal.

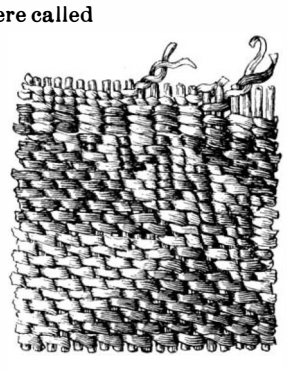


Fig. 3.—Texture of Pomo Indian Basket.

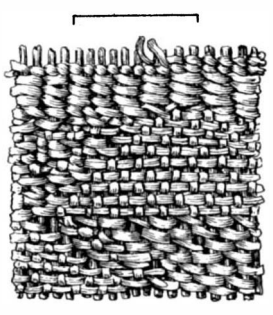


Fig. 4.—Inside Technique.

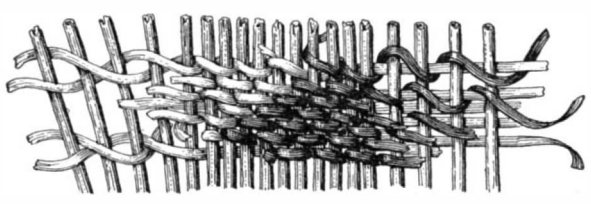


Fig. 5.—Outside Technique and Lit Twine.

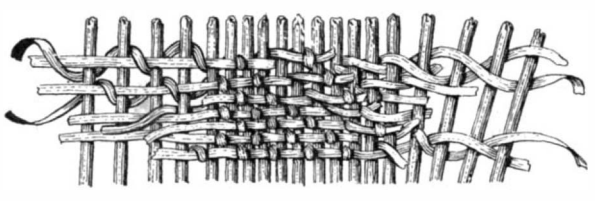


Fig. 6.—Inside View of Diagonal and Lit Twine.

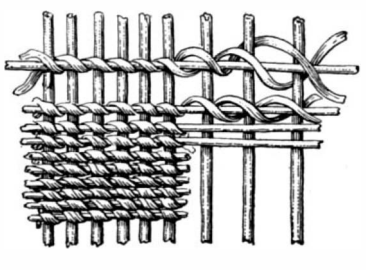


Fig. 7.—Outside View of the Pomo Tee or Hudson Stitch.

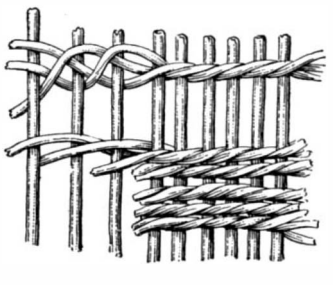


Fig. 8.—Outside View of Three-Ply Twined Weaving.

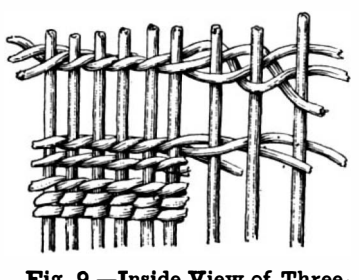


Fig. 9.—Inside View of Three-Ply Twined Weaving.

TYPES OF AMERICAN INDIAN BASKETRY.

These two warps are held compactly together, as shown in Fig. 7, by plain twined weaving with two weft elements. On the inside, tee ware does not differ in appearance from type one, but on the outside the stitches have a wrapped look. On all tee ware the ornamentation is in bands of two colors.

THREE PLY TWINED WEAVING.—The bottom of Fig. 2 is in three-ply technique, which is better set forth in Figs. 8 and 9. It is, in fact, a variety of diagonal work, since two warp stems are necessary to each stitch. The woman holds three weft filaments or splints in her left hand, makes a third of a turn with them, catches with her right hand one weft over a warp stem, then makes another third of a turn, catching a weft over a warp, and so on. The result is plain twined weaving on the inside and diagonal twine on the outside. The process is never reversed so as to bring the plain stitch on the outside, since that would leave a bungling job on the interior. Braided twine is only a fanciful variety of this type and is seldom used. Three-ply twine is found nowhere covering the entire surface of a basket, but it is employed for bottoms and for strengthening bands, especially in the great interior basin.

Members of the Bascuada Fraternity should leave no stone unturned to ascertain beyond the shadow of a doubt for each basket the name of the Indian tribe to which the maker belonged, the botanical and Indian name of every plant employed, and the meaning of every design. Later on we shall discuss plated ware and coiled ware.

Cost and Limitation of Electric Vehicle Traction.

BY ALTON D. ADAMS.

Though the electric vehicle follows every movement of the operator's hand, it is as truly driven by the power of the great engine at the distant generating station as is the dynamo on its shaft. At each transformation between the engine and the distant moving vehicle a portion of the work done in the steam cylinder disappears as useless heat. The electric generator probably delivers ninety per cent of the mechanical work expended at its shaft in the form of electrical energy. The vehicle battery may return about eighty per cent of the watt hours which it absorbs from the generator, and the driving motor ought to change three-fourths of the energy given out by the battery into motion at the wheels. On the basis of these figures the work done by the vehicle motor should be $0{\cdot}9 \times 0{\cdot}8 \times 0{\cdot}75 = 54$, or fifty-four per cent of the horse power hours delivered on the dynamo shaft.

A knowledge of the relative cost of energy, as furnished by the horse and by the steam engine, is consequently the first step to a correct appreciation of the possibilities in electric vehicle traction.

A fair conclusion from the best data at hand and from experience seems to be that a good horse, traveling at from six to eight miles per hour when in motion, and with frequent stops, can do on the average, day after day, about 6,000,000 foot-pounds of work daily. This work corresponds to a daily travel of about nineteen miles over well-paved, nearly level city streets, drawing a wagon that weighs with load from 2,000 to 25,000 pounds, the constant pull or traction on the part of the horse being taken at 60 pounds.

The conventional unit rate of work, or horse power, is 33,000 foot-pounds per minute; but it is well known that this rate is much beyond the continuous daily performance of the average horse. A low figure for the daily maintenance of a horse may be taken at 60 cents, covering all regular expenses and divided about as follows: Feed, 35 cents; rent of stall, 10 cents; attention, 10 cents; and shoeing, 5 cents. Allowing the horse one day of rest in seven, which will be necessary in order to maintain the assumed rate of work, his useful service per week will be $6,000,000 \times 6 = 36,000,000$ foot pounds, or eighteen horse power hours.

The weekly maintenance charge for the horse is $60 \times 7 = 420$ cents, so that the cost of his work per horse-power hour is $420 \div 18 = 23{\cdot}3$ cents. As most electric vehicles will probably be supplied with energy from regular central stations, for the present at least, the public power rates are a satisfactory basis for comparison with animal power. Electrical energy is now sold from many central stations for power purposes at not more than 3¼ cents per horse-power hour, and there is no reason to suppose that a higher rate will be charged for service to electric vehicles. On the contrary, the ability of the electric vehicle to draw its energy from the generating station at the times of light load when most of the equipment would otherwise be idle, will insure it the lowest rates made for any service. As a matter of fact, the charging rates for automobiles at certain times of day in New York city are now materially below the above figures.

Taking the efficiency of vehicle batteries at 80 per cent and of the motor at 75 per cent, as stated above, their combined efficiency becomes $0{\cdot}80 \times 0{\cdot}75 = 0{\cdot}60$, or 60 per cent, so that for each horse-power hour exerted by the motor on its vehicle the battery must draw $1 \div 0{\cdot}6 = 1{\cdot}66$ horse-power hour from the generating plant. The cost per horse-power hour of energy actually expended in propelling the vehicle, as is the work of a horse, is therefore $3{\cdot}33 \times 1{\cdot}66 = 5{\cdot}53$ cents. Comparing this sum of 5·53 cents with the amount found above, covering the same work on the part of a horse, shows the unit of work applied to a vehicle by the horse to be $23{\cdot}3 \div 5{\cdot}53 = 4{\cdot}2$ times as expensive as when the same work is applied by the electric motor.

Having noted the costs of driving power for horse and electric vehicles, and the great saving effected by the latter, it remains to determine the nature, arrangement, weight, and capacity of the electrical equipment. The main necessary difference between the electrical and the horse vehicle lies in the addition of a storage battery and an electric motor. The battery is charged from any proper source of electrical energy and if not used will retain its charge for an indefinite time. The nature of the battery is such that its energy can be drawn from it either very slowly or quite rapidly, as desired, which well suits it to the irregularities of practical service. When necessary the battery is capable of exerting a power several times greater than its normal rating during short periods, but the efficiency or ratio of energy given out to that required for a charge is reduced somewhat, while the very high rate of work is kept up.

An advantage of the battery is that, being made up of small units, any desired capacity can readily be secured by the addition of just the necessary number of cells. This property of small variations in capacity is in contrast to the necessities of horse traction, where, if one horse is not enough, for a given work, another must be added, and the capacity thus doubled. At present there is material variation in battery weights per unit of capacity with different makers, the general rule being that the lighter the weight of battery per horse power hour output the shorter its life. There is some compensation for the shorter life of high-capacity batteries in their tendency to a lower first cost. Moderate figures for battery weight and capacity may now be taken at one horse power rate of work for each 300 pounds of battery at normal discharge, and one horse-power hour capacity for each 90 pounds of battery. On these figures the battery working at normal rate will be discharged in the number of hours indicated by $300 \div 90 = 3{\cdot}3$. If, however, the battery is worked at less than its greatest normal rate, so as to be discharged during six or eight hours, its efficiency is increased and an output greater by 15 to 25 per cent obtained from a single charge. If the object in any case is to equip an electric vehicle with the smallest practical weight of batteries, it can be done by allowing the full normal rate of discharge at average speed, and the battery weight will then be a very moderate item.

If, however, the battery is thus discharged at its maximum regular rate, the time of action will be short before a new charge is required, as indicated above, and the efficiency may be as low as 60 to 70 per cent. There are, no doubt, some vehicles intended for short periods of use and high speeds, in which light weight is of enough importance to warrant the constant use of batteries at their full normal discharge rates. The great majority of vehicles, however, require to be in use during times and over distances between charges that preclude the constant use of batteries at their maximum rate of work, and for these cases the batteries must be selected on their horse-power hour capacity, rather than for their maximum horse power or rate of work. The construction of efficiency or cost of operation is of more moment with the average vehicle than a few hundred pounds of weight one way or the other. Numerous tests on a variety of both light and heavy electric vehicles show that the energy consumption per ton mile on fairly level roads may be safely taken at an average value of 0·16 horse-power hour, so that $90 \times 0{\cdot}16 = 14{\cdot}4$ pounds of a battery having a capacity of one horse-power hour per 90 pounds of weight are required per ton-mile of vehicle travel. Thus, a vehicle that is to travel twenty-five miles between charges, and weighs complete with passengers and load 2,000 pounds, should have a battery weighing about $14{\cdot}4 \times 1 \times 25 = 300$ pounds. The relation pointed out between weight of battery and the ton-miles of vehicle travel shows that the amount of battery required for any particular vehicle depends directly on the distance to be traveled between charges and the total weight carried. If, therefore, the above vehicle may have its battery charged once for each fifteen miles of travel, the battery weight may be reduced to three-fifths of its necessary weight for a travel of twenty-five miles, that is, to about 216 pounds. Or again, if the total weight of vehicle fully loaded can be kept at 1,000 pounds, it may travel twenty-five miles between charges with one-half the previous weight of battery; that is with 180 pounds. When it is desired to reduce battery weight simply through frequent battery charges, a limit is soon reached unless speed of operation is cut down along with the length of runs. This last condition is due to the fact that the battery should weigh about 300 pounds per horse-power rate of work required. Take, for example, a vehicle that weighs one ton complete and may be charged once for each ten miles run. The ton-miles of this vehicle are $1 \times 10 = 10$, and the weight of battery to drive it this distance is $14{\cdot}4 \times 10 = 144$ pounds, but on the basis of 300 pounds of battery per horse-power rate of work the battery in this case should only be called on for a rate of $144 \div 300 = 0.48$ horse-power. One horse power hour develops 1,980,000 foot pounds of work, so that 0·48 horse-power hour will furnish $1{,}980{,}000 \times 0{\cdot}48 = 950{,}400$ foot-pounds.

The 0·16 horse-power hour previously found necessary per ton-mile develops $1{,}980{,}000 \times 0{\cdot}48 = 316{,}800$ foot-pounds, so that the greatest regular speed for this vehicle should only equal $950{,}400 \div 316{,}800 = 3$ miles per hour. At this speed the vehicle will cover the ten miles in $10 \div 3 = 3{\cdot}33$ hours, which is about as short a time as should be allowed for the full discharge of a battery.

Motors of either two, three, or five horse-power at normal rating are used on most vehicles thus far built, and the approximate weights of these sizes may be taken at 150, 200, and 260 pounds respectively. The motor power ratings above given are subject to an increase of as much as 100 per cent during a few minutes at a time without material injury to the motor. As the energy required per ton-mile is very nearly the same for large and small vehicles, the cost of operation for any desired loads and distances can be readily calculated on the basis of 0·16 horse-power hour per ton-mile. For example, a vehicle weighing 1,000 pounds complete with load will consume energy to the value of $0{\cdot}5 \times 0{\cdot}16 \times 3{\cdot}33 = 0{\cdot}266$ cent per mile of travel, on the rate of 3·33 cents per horse-power hour for electric energy, as above stated.

Allowing a horse to travel twenty miles per day with the 1,000 pound vehicle, the cost per mile is $60 \div 20 = 3$ cents, on a charge of 60 cents per day for horse maintenance, thus making the cost with horse about eleven times that with electric power. With the horse the cost of light and heavy loads per mile varies constantly and cannot fall below a certain minimum per day, no matter how small the work done. The horse has a certain radius of action for a given load which cannot be regularly exceeded. The electric vehicle has a daily radius of action much greater than that of the horse, and within wide limits is nearly independent of the load for its speed.

Archæological News.

Thirty thousand copies of the "Logia" have already been printed by the Egyptian Exploration Fund, and the demand is still continuing.

Prof. Lanciani, the archæologist, has received the Royal Gold Medal at the Architectural Congress. He is the second representative of Italy to receive this medal. In 1849 it was presented to Canina for his literary work in connection with art and architecture.

Princeton University has received from Mr. McCormick a collection of Indian pottery, stone implements and articles used in religious ceremonies of the Hopi Indans of Arizona. This gift will supplement the large collections which the University already possesses of Mexican and Peruvian pottery.

An interesting collection of stone implements has been obtained from the Nile Valley by Mr. Seton-Karr. The material is chiefly yellowish-brown or pearl-gray, opaque, earthy chert, and is but rarely of the translucent, chalcedonic variety as found in the chalky formation of England. The collection contains a large number of types, which may be classed as bracelets, ax-like tools, leaf-shaped flints, knife like instruments, hoes or agricultural implements, scrapers, cores and flakes.

Dr. Wolfgang Reichel, whose work on Homeric armor is familiar to all classical archæologists and Homeric scholars, has just published, says The Builder, a tract on "The Cults of the Gods in pre-Hellenic Days" (Ueber Vorhellenische Götterculte), which opens up a new chapter in Mycenæan and Homeric archæology. From a careful scrutiny of Mycenæan "finds," he has come to the conclusion that in Mycenæan days the object of worship was, in the main, not the image of the god, but his throne on which invisible to mortal eyes, he took his seat. Schliemann himself long ago drew attention to the number of little empty terra-cotta seats or thrones found in graves at Tiryns, Mycenæ, Menidi, Nauplia. A similar empty throne appears on a gold ring found at Mycenæ, and is approached by three female figures with gestures of adoration. These seats, or thrones, Dr. Reichel believes, were originally altars, and it will interest biblical scholars to learn that the "ark of the covenant" is supposed to have been such a movable throne. Just such a portable throne is described by Herodotus (vii., 40), as accompanying Xerxes on his military expeditions. Again and again in his account of antiquities, preserved in very primitive sanctuaries, Pausanias notes these imageless thrones. The famous peplis of Athene was, Dr. Reichel thinks, laid on such a throne on the knees of the invisible goddess. In a word, he holds that Mycenæan worship was aneikonic. His theory is supported by a mass of carefully-collected evidence, and, whatever may finally be thought of it, deserves attention.

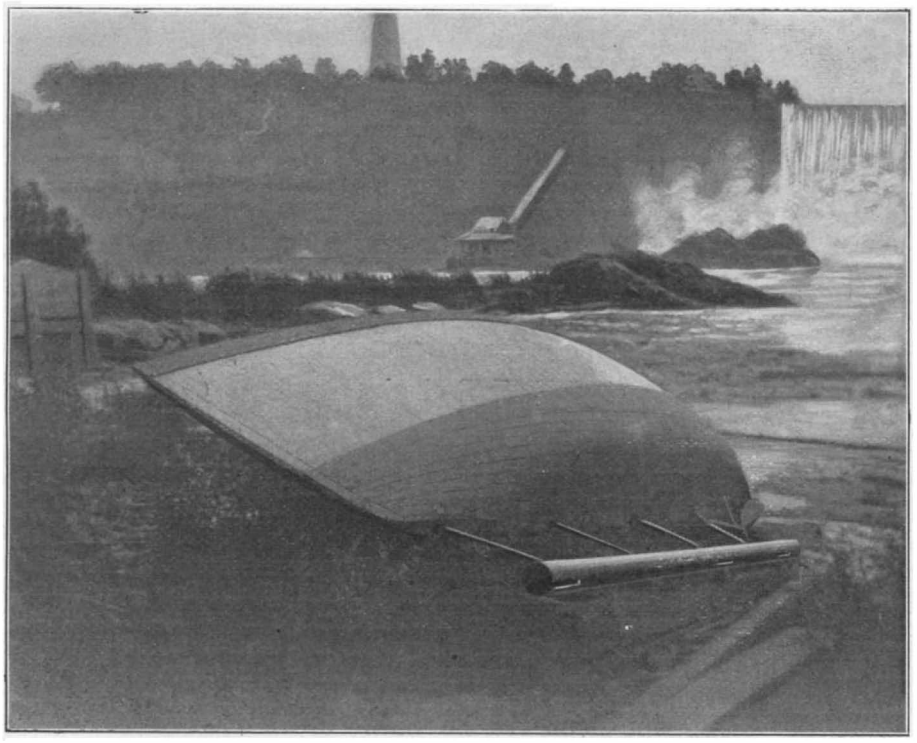
THROUGH NIAGARA WHIRLPOOL RAPIDS IN A BOAT.

On July 9, Peter Nissen, of Chicago, made a successful trip through the Whirlpool Rapids at Niagara, being the first man to go through in an open boat and come out unharmed. He entered the Rapids at 5 P. M., the boat gliding down easily bow first, entering the first wave end on, and going partly over and partly under the water, which drenched completely Nissen, or Bowser, as he prefers to be called. The second wave struck him with terrific force, almost broad side, the boat being partly turned by the first wave, smashing Bowser against the cockpit, knocking off his hat and nearly smothering him. A moment later he entered the frightful mass of warring waters opposite the Whirlpool Rapids Station, and for a few moments it looked as though his end had come, the boat being tossed with terrific force almost out of the water, broadside up, the iron keel, weighing 1,250 pounds, being plainly seen. Boat and occupant then disappeared altogether, not being again seen for several seconds until it was feared that Bowser had met his death. Suddenly both man and boat reappeared farther down stream and the hundreds of onlookers gave vent to their feeling in cheers. Under the waters the hardy navigator again went, receiving a crushing blow as he entered every succeeding wave until the stanch craft and its master finally entered the Whirlpool. But he was not yet safe. Having no means of guiding or propelling the boat, Nissen was compelled to sit in the water in the cockpit for 50 minutes, being carried around the Whirlpool four times. Once the boat approached the vortex and was sucked down about half its length, the other half standing out of the water in an almost vertical position. It was immediately thrown out, however, and resumed its course around the pool. When at the farther end, where the current has the least strength, the boat then being about fifty feet from shore, three young men swam out with a rope and fastened it to the boat, which was then drawn a shore by very willing hands.

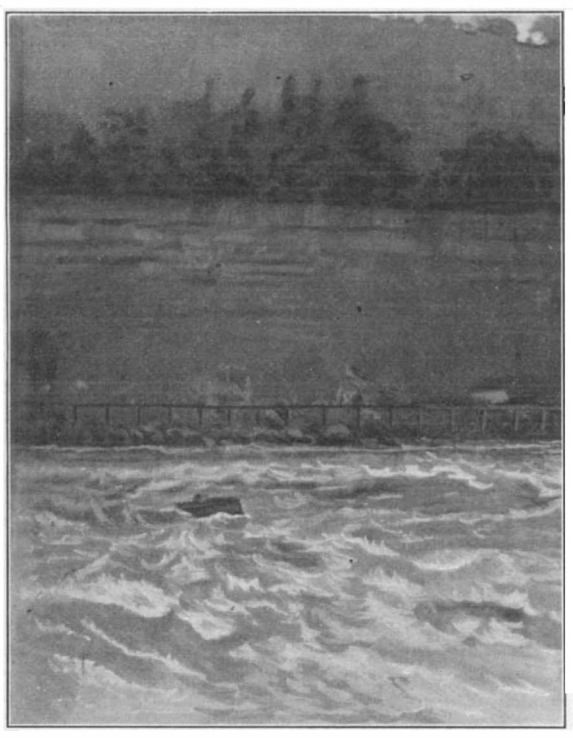
Bowser, when questioned, said he was not injured in the least, only feeling cold and weak. He was stripped and given dry clothing, and he then declared he felt all right. In making the trip Bowser wore his usual clothing, putting on an ordinary life preserver to aid him if he should be thrown out. He did not intend to fasten himself in the boat, but at the last moment passed a rope over his shoulders, which undoubtedly saved his life.

The boat, which he named the "Fool Killer," was 20 feet long, 4 feet wide, and 4 feet deep. The deck was slightly raised in the center, gently sloping to the gunwales. In the center of the deck a cockpit 4 feet long and 20 inches wide extended down to the keel, a distance of 4 feet. The side planking of the cockpit was carried above the deck, forming a combing 6 inches in height, 6 water-tight compartments were built in the boat, two at each end, and one each side of the cockpit, 300 pounds of cork were also used, so that the boat was unsinkable. The main feature of the boat was the keel. This was a shaft of round iron, 4 inches in diameter and 20 feet long, hanging 2 feet below the bottom of the boat, and held in position by five 1-inch iron bars.

Our photographs were taken by Mr. G. E. Stonebridge, who also wrote the article.



THE "FOOL KILLER," SHOWING CONSTRUCTION OF KEEL.



THE BOAT PASSING THROUGH THE WHIRLPOOL RAPIDS.

THE new forts at Dover, England, are to have six 9-inch wire-wound guns, having an effective range of eleven miles. They are nearly 40 feet long.

Diffusion of German Capital.

A report has been recently made by the German Government, aided by its foreign consuls, as to the diffusion of German capital in the different countries, with the exclusion of Europe (all but Turkey) and the United States. It thus appears that the capital engaged in foreign countries reaches a total of nearly 2 billions, in which its employment in commerce enters for a large figure. It is especially in America, without counting the United States, that German capital is largely distributed, the total reaching one billion and a quarter. In Canada 6¼ millions are employed; in Mexico, 50 millions; in Central America, including Guatemala, Costa Rica, Nicaragua, San Salvador, and Honduras, 63 millions; in the West Indies, 63 millions, including Cuba, with 38 millions. The figure for Venezuela is 50 millions; for Colombia, 25 millions; for Peru and Ecuador, 25 and 30 millions respectively, with 68 to 75 millions for Chili; the Argentine Republic figures for 150 millions; Paraguay and Uruguay, 25 millions. For Brazil the official figures give 150 millions, while the commercial statistics give but 88 millions. Into these figures the railroads enter for a large part; for the whole of South America, on the east coast, the total reaches 250 to 375 millions. The German commercial houses have a capital of 50 millions in Argentine Republic. In the city and province of Buenos Ayres are over 500 German farms, representing over 38 millions of capital. At Buenos Ayres the German industry is represented by 1·6 millions. At Paraguay, in a total of 17,000 foreigners, over 12,500 are Germans. The property possessed in Uruguay and Paraguay is valued at over 3 millions. At Rio de Janeiro, San Paolo, and Rio Grande there are 147 German commercial houses, having a total capital of 38 millions.

Orris Benson's Progress.

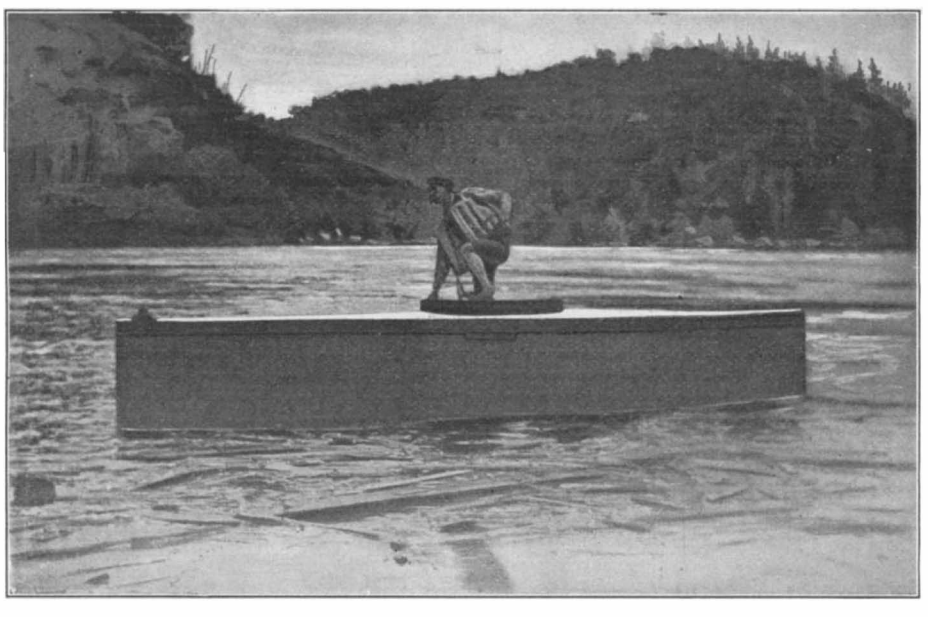
The progress which Orris Benson, the deaf, dumb, and blind boy is making is quite remarkable, and the scientific treatment which he is receiving at the New York Institution of the Deaf and Dumb has made him a cheerful inmate, as he carries on conversation with the use of the sign language by the sense of touch. He can converse also by speech. He has a great fondness for history and geography, and he has also made considerable progress in arithmetic. He can do chair caning, carpentry work, and even manages to earn considerable money during his vacation. He is showing an excellent intellect, and the similarity of his case to that of Helen Keller is attracting wide attention. It will be interesting to see the development of these two minds which, but for the patient and scientific instruction of their teachers, must have passed through life wrapped in Cimmerian darkness.

Foreign Commerce of the United States for 1900.

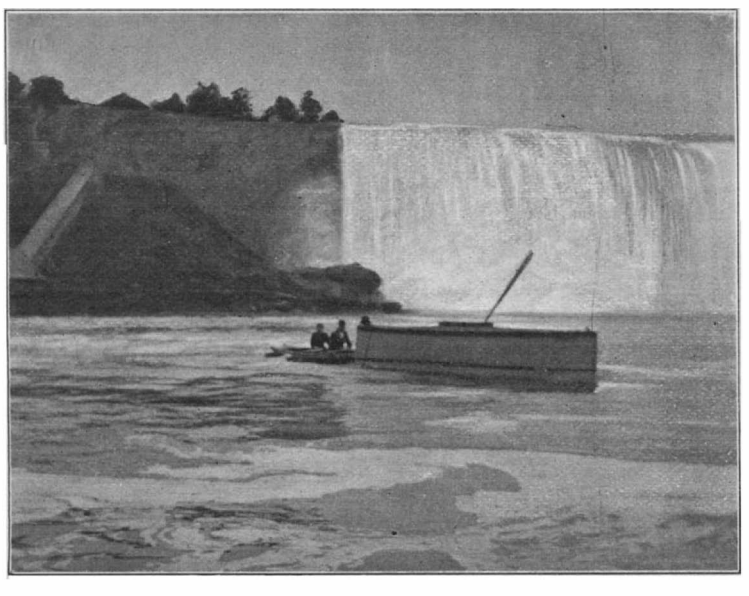
The total foreign commerce of the United States during the fiscal year, 1900, exceeds by 16⅔ per cent that of any preceding year, being $320,000,000 greater than that of 1899, the heaviest year on record preceding the one which has just ended. The total commerce of the year is $2,244,193,543. The exports are $1,394,479,214. The imports are also heavy, especially in the class that includes articles in a crude condition which enter into the various processes of domestic industry. The most notable features of the year's commerce are: 1, the increase in imports of all manufacturers' materials not produced at home; 2, the increase in exports of manufactured articles; and 3, the fact that the foreign commerce for the first time in the fiscal year record crossed $2,000,000,000 line.

The Tropical Army Ration.

Dr. L. L. Seaman offered, through the Military Service Institute, a prize for the best essay on the ration for use of the army in the Tropics. Dr. Munson's essay received the prize. He considers that the present army ration contains too much nitrogenous food and hydrocarbons and not enough carbohydrates; also that the ration is too generous. The sugars and starches should be slightly augmented.



THE RESCUE OF MR. NISSEN AFTER HIS ADVENTUROUS TRIP.



TOWING THE "FOOL KILLER" TO THE AMERICAN SIDE.

Report of Commissioner of Patents Duell.

The following report of the business of the United States Patent Office for the fiscal year ending June 30, 1900, has been made by Commissioner of Patents Duell:

APPLICATIONS AND CAVEATS RECEIVED

Applications for letters patent	39,815
Applications for design patents	2,263
Applications for reissue patents	90
Applications for registration of trade marks	2,103
Applications for registration of labels	872
Applications for registration of prints	127
Caveats	1,739
Total	47,009

APPLICATIONS AWAITING ACTION.

Number of applications awaiting action on the part of the office on July 1, 1900	3,564

APPLICATIONS FOR PATENTS, INCLUDING REISSUES, DESIGNS, TRADE MARKS, LABELS, AND PRINTS.

June 30, 1891	43,616
June 30, 1892	43,514
June 30, 1893	43,489
June 30, 1894	39,206
June 30, 1895	41,014
June 30, 1896	45,645
June 30, 1897	47,747
June 30, 1898	44,216
June 30, 1899	40,320
June 30, 1900	45,270

PATENTS GRANTED, AND TRADE MARKS, LABELS, AND PRINTS REGISTERED.

Letters patent granted (including reissues and designs)	26,540
Trade marks registered	1,660
Labels registered	682
Prints registered	93
Total	28,975

Summarizing these tables there were received during the year 39,815 applications for mechanical patents, 2,263 applications for designs, 90 applications for reissue, 1,739 caveats and 127 applications for prints. There were 26,540 patents granted, including reissues and designs; 1,660 trade marks, 682 labels and 93 prints were registered. The number of patents that expired was 19,988. The total receipts of the office were $1,358,228.35, the total expenditures were $1,247,827.58, and the surplus of receipts over expenditures, being the amount turned into the Treasury, was $110,400.77.

The examination work of the office is in about the same relative condition that it was at the close of the fiscal year ending June 30, 1899. At that time every examiner had his new work within one month from date of filing and his amended work within fifteen days of date. At the close of the present fiscal year thirty out of the thirty-six examiners had their new work within one month from the date of filing. Of the remaining six, three overran that time by but one day. The amended work in nearly all of the divisions was being acted upon within fifteen days after filing. The number of applications awaiting action on the part of the office on July 1, 1900, was between five and six hundred more than on the 1st of July, 1899, but the number of applications for patents, etc., received during the last fiscal year was 5,000 greater than during the preceding year, and the number of amendments acted upon was also correspondingly greater.

This is considered an excellent showing, Commissioner Duell says, and reflects credit upon the examining corps when it is borne in mind that a greater number of examiners were detailed for classification work than during the preceding fiscal year.

The work of the clerical divisions has been kept well up to date, and there is no reason why, he says, with the small increase of clerical force given by Congress at the last session, the work of the clerical divisions should not be promptly and carefully done.

During the last month of the fiscal year it was found possible to give to this division much needed room. This will enable a larger force to economically perform the valuable work now being done by the chief of the classification division and his carefully selected corps. The work of this division during the past fiscal year has continued, and, while the amount accomplished is not perhaps as great as was hoped for, yet it is but fair to say that with the additional room and force much of the incompleted work of the past year will be finished.

Commissioner Duell says:

"As yet this bureau has derived little or no advantage from the removal of the General Land Office. The additional room which has been assigned, under your direction, to this office is, I regret to say, inadequate for its needs. It demonstrates that the Patent Office building is too small to meet the needs of the Interior Department proper and this office. As the building was originally planned and designed for the Patent Office, and very largely paid for by money paid into the Treasury by the inventors of the country, it would seem as though the entire building should be applied to the uses of the Patent Office. This, however, does not seem to be feasible, and I therefore express the hope that at an early day a new building may be erected for the sole use of the Patent Office, and I bespeak your powerful influence with Congress to aid the passage of Senate Bill No. 1,159, which provides for the construction of a fireproof building for the use and accommodation of the Patent Office, including a hall of inventions.

"Legislation in this direction is favored by many societies and associations interested in the subject of invention, and by hundreds of progressive manufacturers and inventors who have addressed petitions to Congress in the matter. The surplus receipts of the United States Patent Office for the past ten fiscal years amount to more than $2,000,000, while the total excess of such receipts turned into the Treasury amounts to over $5,000,000. Aside from this, the United States owes a debt to inventors which it can never repay. A slight recognition of this debt, however, would be the erection of a building such as referred to, which might be considered in the nature of a monument. The necessity for some action on the part of Congress is pressing and should not be longer delayed.

THE SCIENTIFIC LIBRARY.

"This library," says the report, "consists of over 70,000 bound volumes, and a conservative estimate of its value is $200,000. It would, however, be impossible even with this amount, or with any sum, to replace the library should it be destroyed by fire. Many of the most valuable works are out of print. Our books are not now safely stored, and while in this building it is impossible to wholly protect them from fire, yet much might be done in this line by the use of steel stacks, which are now in common use in every modern library building.

LEGISLATION.

"In submitting my estimates for the present fiscal year my suggestions in the main were approved by you, with the result that many of them so approved were favorably acted upon by Congress. Your action in this matter was appreciated by the inventors and manufacturers of the country.

"Something more in the line of readjustment of salaries and a reclassification of the clerical force of this office is needed, and in submitting my estimates for the next fiscal year your attention will be called in detail to such matters."

The Current Supplement.

The current SUPPLEMENT, No. 1282, has many articles of unusual interest. "The Burial Grounds of the Ming Dynasty" illustrates the colossal statues of men and animals which grace this very curious cemetery. "Russian Central Asia, Countries and Peoples," by Archibald R. Colquhoun, is a particularly timely article, accompanied by an excellent map. "Some Twentieth Century Problems" is a vice-presidential address of the Section of Botany of the American Association for the Advancement of Science. The second of the remarkable series of papers on "American Competition" is given in this issue.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

COTTON-DISTRIBUTER. — JOSEPH A. PARKER, Dripping Springs, Tex. The invention provides a means for equalizing the distribution of cotton to a series of connected receptacles, and for retaining the cotton in the receptacles until it is desirable to deliver it to the hoppers or feed devices for cotton-gins. The current of air employed to deliver cotton to the receptacles, can be so regulated that it can be made either to draw or retard. A storage-receptacle is provided for each gin. The controlling devices for the receptacles are so constructed that either the right-hand one or the header can be cut out without interfering with any of the others.

Bicycle-Appliances.

REPAIR-JACK.—MARSHALL A. MASTERS, Montrose, Colo. In repairing and assembling bicycles, it is convenient to have some means for holding the bicycle, by which it may be adjusted to any desired position. Such an appliance the inventor has devised. His jack comprises a standard to which an arm is swiveled, projecting horizontally. A cross-bar is secured to the outer end of the arm by a fixed and by a swinging pivot at right angles to each other. Bicycle-holding clamps are provided upon the cross-bar. By means of this jack, the bicycle can be raised or lowered, turned or adjusted in every conceivable position.

Electrical Apparatus.

ELECTROLYTIC APPARATUS. — NATHANIEL L. TURNER, Salmon City, Idaho. This apparatus for the electrolytic separation of gold, silver, and the like in solution, prepared pulp, and slimes comprises a tank; a carrier provided with depending arms; an electrode supported by the arms; turn-buttons secured to the arms; and an electrode of opposite polarity to that first mentioned. The solution is placed in the tank and agitated while the current is turned on, so that dissolution and precipitation proceed simultaneously. The larger the number of anodes and cathodes, the quicker will be the precipitation. All gold, silver, or other metal is quickly deposited on the plates of the cathodes. When the proper amount of metal has been deposited, the carrier is raised with the cathodes and anodes.

Mechanical Devices.

HOOP-RACKING MACHINE.—CHARLES REED, Portland, Ind. In making hoops from lumber, it is customary to split the wood into bars which are of a thickness corresponding with the width of the hoop and of such width as to make a number of hoops. These are then checked at one end and split into separate hoops. Mr. Reed's machine takes bars which are thus prepared by being checked at the ends, and splits them up into hoops by passing them through the machine.

Railway-Contrivances.

RAIL-JOINT FASTENING.—ANNIE B. SCHIMMEL, Portland, Ore. The fastening comprises an angle-bar having two sets of teeth, and a locking-plate having means for engaging bolts and also having two sets of teeth. The teeth of the plate are so related to the teeth of the bar that, when adjacent sets of teeth of the plate and bar are in mesh, the other sets of teeth will be out of mesh. By reason of this construction, the use of a nut and nut-lock is rendered unnecessary; and the angle-bars at the points of the rail-sections are effectually and positively tied in place. The locking-plate cannot be loosened by any vibration in the rails and can be detached only by violently and repeatedly striking one of its ends.

Musical Instruments.

MUSICAL INSTRUMENT. — MANUEL MONTOYA, Bogota, Colombia. The instrument is of the mandolin type and has a hollow body comprising a top and bottom connected by a peripheral wall. This wall consists of an outer layer of celluloid and an inner layer of wood glued together. A tail-piece is also provided having at its front end a series of notches for the passage of strings and at the rear of the notches a series of apertures with notches and projections between them. The invention provides a very strong construction of the body without interfering with its resonancy, as well as a tail-piece or tuning the strings perfectly.

STRINGED MUSICAL INSTRUMENT. — ERNST EULERT and ADOLF WALLENSTEIN, Manhattan, New York city. The purpose of this invention is to provide a new cithern-like instrument arranged to enable the performer to play the desired accompaniment to the melody and to play the melody on either of the usual leading cithern strings, or on an open scale of strings. The accompaniment-strings extend over frets; and a number of independent, movable pitch-changing bars extend transversely over the accompaniment-strings and are arranged between adjacent frets. Individual buttons press and move each of the bars in engagement with the accompaniment-strings to press them upon the corresponding fret.

Vehicles and Accessories.

VEHICLE.—CLARK C. HYATT, HARRY W. WATSON, WILLIAM WILDANGER, and CYRUS B. SANDERSON, Flint, Mich. The invention provides a body for cutters and sleds, which body is arranged to permit one conveniently and quickly to change the vehicle from a single-seated one to a double-seated one, or vice versa. The rear portion of the body is protected from dust when only a single seat is used.

HAME-TUG. — JAMES T. DEDMAN, Sullivan, Ill. This coupling for a trace and hame-tug is so constructed that much less leather is required in the making of the tug. The sections can be rendered adjustable and can be securely locked in adjusted position by means of a very simple locking device. The coupling tends to strengthen the parts and dispenses with the necessity of loops.

SINGLETREE-COUPLING. — AMOS M. BARKER, Bloomington, Neb. Mr. Barker has devised an improved means for attaching singletrees to a doubletree, which means permit a more extended range of movement of the singletrees than is at present attainable. The pivotal connection between the singletrees and doubletrees is, moreover, rendered more durable, The singletrees can be raised and lowered relatively to the doubletrees, if desired.

Miscellaneous Inventions.

SPARK-ARRESTER. -- MARTIN BROTHERS, Evergreen, Colo. The spark-arrester can be readily attached to the top of any smoke-stack, pipe, flue, or chimney. The arresting, collecting and escaping screen is constantly rotated by the natural or forced draft through the chimney, so that sparks, cinders, and escaping coal are caused to be conveyed to a receptacle in which the coal is collected and from which it is conducted back to the firebox. We have been assured that the device is very efficient in its operation.

LIFE-PRESERVER.—ZENUS C. ANGEVINE, Brooklyn, New York city. The inventor has devised a new life-preserver or jacket, having not only means for keeping a person afloat in the water, but also receptacles for holding food and drink, signaling devices, and instruments.

SHOE-LAST. — CHARLES C. TANNERT, Brooklyn, New York city. This shoe-last has hingedly-connected heel and toe sections. The toe is formed with a cavity in its rear face; and in the cavity a push-plate is mounted, engaged by a spring so that it tends to move rearward. A dog is mounted on a constant pivot in the cavity of the toe-section and has a pointed free end engaged by the push-plate, such point being situated above the pin, whereby to throw the free end of the dog downward into engagement with the heel. Thus a ready means is provided for removably holding the heel and toe-sections of a shoe-last extended.

HAT-FASTENER.—ELIZABETH S. SWANK, Wolcottville, Ind. The hat-holder comprises a frame designed to be attached to the inside of the crown of a lady's hat. The frame has guideways through which an elastic loosely extends. Looped hair-pins are secured at the ends of the elastic outside of the guideways. A hook on the frame is adapted to be engaged by the middle portion of the elastic. The device is always in proper condition for conveniently securing the hat in place, by simply taking hold of the loops of the hair-pins, drawing them outward, and finally passing the hair-pins into the hair to allow the elastic to draw the hair-pins firmly in position on the hair, releasing the hold on the loops.

KINETOSCOPE ATTACHMENT FOR STEREOSCOPES.—FRANK MONIOT and LOUIS GARCIN, Manhattan, New York city. The object of the invention is to provide a stereoscope so arranged that it may be used for viewing pictures in the usual manner and also for viewing "animated pictures"—that is, having an attachment by the operation of which the figures of a picture under view will have the appearance of moving. This attachment consists of a novel shutter which, when rapidly operated, causes the viewed figure apparently to move.

STEAM-JET TUBE OR FLUE-CLEANER. — WORTHINGTON H. INGERSOLL, Hamburg, N. J. At the larger end of a conical blower-head a steam-supply pipe is secured. On the exterior of the blower-head are spaced flanges. On the small end of the blower-head is a nozzle with a spiral rib formation extending along its inner side. The twists of the ribs give the steam-jet a spiral turn, so that the induced hot current of air will also assume a spiral twist and coact with the spiral steam-jet in order forcibly to loosen clogging soot.

DEVICE FOR MAKING LOOPS IN WIRE. — CHARLES R. HARTMANN, Manhattan, New York city. The purpose of the invention is to provide a device which can be carried in the pocket and which is especially adapted for forming eyes or loops at the ends of wire strings for musical instruments, but which can be employed with equally good results where an eye is required at the end of any piece or strand of wire. The device consists of a tubular body carrying a clamp and a forming-arm mounted to turn. This forming-arm is provided with a retaining section for forming a loop of wire, which loop is continued into the body for an engagement with the clamp.

INVALID-BED ATTACHMENT. — MRS. ANNA E. COUNTRYMAN, Marcus, Iowa. The invention provides a simple device by means of which a person can be lifted and removed from the bed when it is desired to rearrange the bedding. An arrangement is also furnished for supporting a person in a sitting position in the bed. At the head and foot of the bed horizontal tracks or rails are supported, on which standards are movable. A sling or hammock is placed under the invalid, and raised up by means of the standards, after which the hammock can be moved rapidly to one side on the rails, so that the bedding can be rearranged. The invalid can also be given a sponge bath without danger of soaking the bedding.

SIGN.—OTTO CAESAR, Manhattan, New York city. The invention relates to letters and designs which are attached to windows to form signs; and its object is to provide a sign that is adapted for attachment to

the inside of a pane of glass and is arranged to give a highly-ornamental effect. The letters can be readily fastened to the inside of the glass pane without destroying their concave appearance, at the same time permitting a cleaning of the window both inside and outside without danger of detaching the letters.

WRENCH.—JOHN J. BARCLAY, Elizabeth, N. J. The wrench comprises a shank with a fixed jaw, a movable jaw, and a retarding spring for the movable jaw. The shank and the opening in the movable jaw receiving the shank are so constructed that the movable jaw can be unobstructedly carried to or from the fixed jaw, and that the movable jaw will remain fixed on the shank as long as it is subjected to forcible engagement with a nut, pipe, or the like.

CABINET. — FREDERICK WADELL. Louisville, Ky. The purpose of the invention is to provide a cabinet for medicines and other articles. The cabinet is so constructed that it can be used as a writing or reading desk. Stationary receptacles are employed in conjunction with a revolving receptacle, which receptacles are so arranged that they may be compactly combined. The revolving receptacles contain an interior chamber not accessible to persons unfamiliar with the cabinet.

BOX.—JEAN H. KASSCHAU, Brooklyn, New York city. This box is a knockdown box so made that its several members can be rigidly and strongly connected without the use of nails, screws, hooks, or staples. The box can be quickly assembled and separated when it is desired to pack the several members closely together for reshipping or storage.

BOTTLE-CAP.—ALFRED L. BERNADIN, Evansville, Ind. Caps for whisky-flasks are ordinarily made of soft metal, with the result that the threads are often stripped when pressure is applied in turning the cap tightly upon the bottle-neck. The inventor has provided a novel form of cap having an inner shell of hard metal, which is threaded to fit the threads of the bottle-neck. An outer shell incloses the inner shell and forms a smooth cover for the cap. Thus a cheaper and more durable cap is provided than is otherwise possible.

BOOT-TREE.—MARY J. HALL, Aspen, Colo. The tree is composed of body sections provided in their inner faces with openings for bearing-pieces for a shaft and sleeve and for a pivot-shaft on an instep-block. This instep-block has its shaft held in the two sections; and the bearing-pieces for the shaft and sleeve have their trunnions held in their respective openings. A rocker is supported on the bearing-piece for the screw-shaft and has means for operating the instep-block. The body-sections are spread by a screw-shaft and retracted by a spring. A threaded sleeve is arranged to operate the rocker.

AERIAL WHEEL.—STEWART CAIRNCROSS, Grafton, N. D. This windwheel is designed to operate pumps, grain-separators, threshing-mills, dynamos, and other small machinery. The wheel comprises a hub, a peripheral frame, wires extending radially between these parts and across the frame diagonally; and a series of sails, composed of flexible material and attached to both the radial and diagonal portions of the wires, whereby they are held in the diagonal position. Each sail is held taut and flat in a plane which is transversely inclined at an angle of forty-five degrees.

Designs.

SCREW.—HERBERT E. KEELER, Manhattan, New York city. The head of the screw is formed with two notches at right angles to each other, instead of one. Thus a screw is provided which can be readily driven into place, since one notch is always in position for the screw-driver.

CLEANER FOR KITCHEN UTENSILS.—WALTER J. TURNBULL, New Orleans, La. The cleaner is a simple, convenient device for cleaning pots in which food has been cooked. Means are provided for holding a dish-rag and for scraping the interior of the utensil.

WATER-TANK CASING.—GEORGE BECKING, 12th Street and C. S. R. R., Chattanooga, Tenn. The front portion of the body of the tank has a central vertical depression or concave, and the projecting corners are convex. The top or cover has an ovolo molding provided with a row of beads on the under side.

NOTE.—Copies of any of these patents can be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

FLAME, ELECTRICITY, AND THE CAMERA. By George Iles. New York: Doubleday & McClure Company. 1900. 8vo. Pp. 398. Price $2.

This book is an attempt to briefly recite the chief uses of fire, electricity and photography, bringing the narrative of discovery and invention up to the close of 1899. As far as the book can, it traces man's progress from the cave man to the twentieth century scientists. It shows how progress has been accelerated by the electric current and the photographic ray. It is a most fascinating book and the story is told in the clearest possible language.

A HISTORY OF POLITICS. By Edward Jenks, M.A. New York: The Macmillan Company. 1900. 16mo. Pp. 174. Price 40 cents.

The book summarizes in a brief, popular form, the record of political action. Like other volumes of the Temple Primers, the subject is treated in a concise form and is admirably adapted for the use of the beginner.

TECHNOLOGISCHES LEXIKON. Handbuch fuer alle Industrien und Gewerbe. Redigert von Louis Edgar Andés. Large octavo. Part I. Vienna: A. Hartleben. 1900. Price per part, 70 cents.

A fitting companion to Hartleben's metallurgical and chemical dictionaries is this new technological lexicon. The first part, which we have just received, shows that the work will be as comprehensive and as thorough as its predecessors.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7223) J. V. McA. writes: There was a very heavy cloud and a downpour of rain accompanied by sharp lightning during which the Methodist Episcopal church was struck and somewhat damaged in its spire. The point of the spire is about 50 feet from the ground and covered with a case of sheet iron. There is no metallic connection with the ground. Directly under the spire, and running half way up is a gas pipe. Three men were working in the church and were unharmed, although two of them were very close to the pipe, one of them not more than 18 inches away. They saw an explosion at a brass fitting which was exposed, but felt no shock. The shingles with which the spire was sided were knocked off all along the one side and at the top where the shingles extended under the sheet iron cap, it looked as if the lightning had gone up instead of down. There was a terrific crash which, to some, seemed to be at a greater distance than the church, and to have been more severe than the one which struck the church. Could it have been that the cloud was charged positively and the earth negatively, and the restoration of the equilibrium, after the discharge, have caused the "fluid" to run up the spire and so have caused this damage? Some of us think so, as so many things seem to point that way. Does electricity ever do damage in rising from the ground? A. We do not know that the electric discharge takes place from + to —. It is conventional to regard it as doing so. Thompson says "No exact evidence exists as to the direction in which the current in a wire really flows." Many people see the lightning go up from the earth to the cloud rather than down. Since the flash lasts but a minute fraction of a second, the eye cannot determine the direction of the motion. We must consider that the impression of downward motion is subjective, and is due to the fact that a downward flow is more natural to us. In clear weather the atmosphere is usually plus to the earth. One observer found it minus but six times in fifteen years. But in stormy weather the sign changes very capriciously and frequently. In thunder storms the change is still more rapid, so that it is impossible to say whether the cloud at the moment of this flash was positive or negative to the earth, or whether the flash went up or down. It may have gone in either direction, or more probably it surged back and forth many times while the flash lasted. The description shows that the gas pipe was not in the path of the discharge. By induction it became charged with electricity, which made the flashes seen by the workmen at the same moment that the flash from the cloud passed by. All pointed objects under a thunder cloud become charged with electricity, and discharge it up toward the cloud, in streams which in the dark can be seen as brushes of light. This is similar to the brushes seen upon the points of an electric machine when it is working in the dark. One may see these brushes if near the top of a lightning rod when a shower is rising. This is what the men in the church saw on an intensified scale, because the grand discharge was going on so near the gas pipe. From what has been shown it is clear that a discharge of lightning will do equal damage in which ever direction it goes. It is the discharge which does the damage, and not any secondary restoration of equilibrium. The supposition of a secondary reaction is not necessary.

(7924) E R. asks: 1. What is the best method for preparing shellac for insulation on magnet wire? A. Dissolve gum shellac in alcohol, equal parts by weight of each. It will probably be easier and cheaper to buy the ordinary brown shellac from a painter. 2. Is the gage of iron and steel wire the same as copper? A. Yes. Ordinary wires of all metals are numbered by the same gage. Piano wire has its own set of numbers by a different gage. 3. What is the resistance of soft iron wire No. 20, per 100 feet? A. 6·1 ohms, very nearly. 4. How does iron compare with copper in resistance? A. Iron wire has 6·06 times as much resistance as a copper wire of the same size and length.

(7925) C. W. asks if you are required to get a license for a steam launch, if you do not use coal for fuel? A. Yes, on all navigable waters in which other vessels ply. The kind of fuel is not considered.

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AND EACH BEARING THAT DATE.

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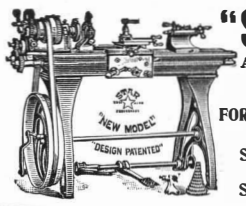

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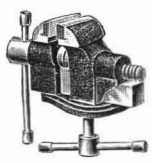

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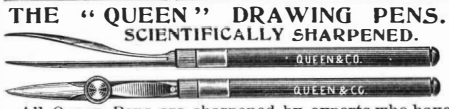

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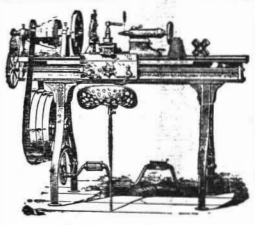

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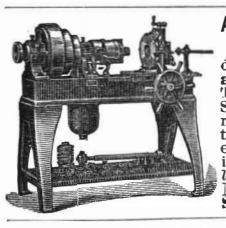

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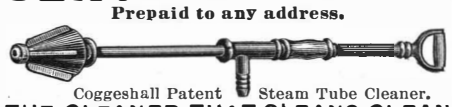

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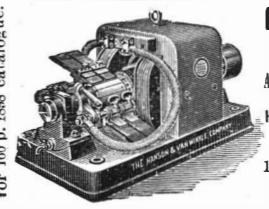

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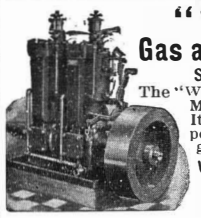

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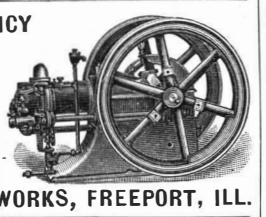

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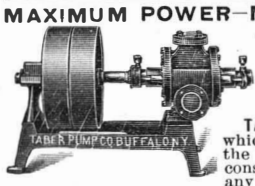

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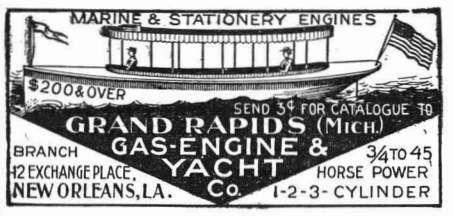
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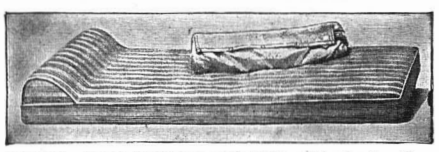

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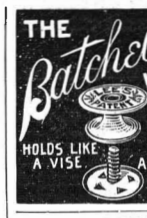

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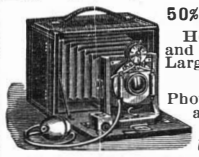

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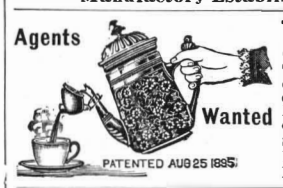

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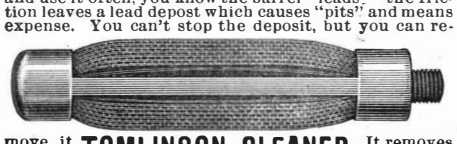

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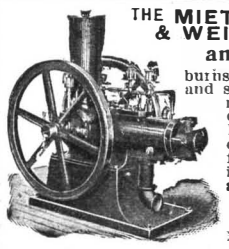

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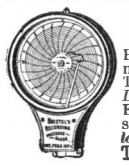

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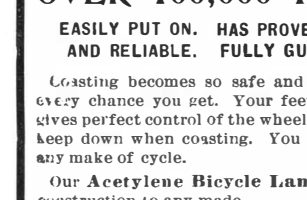

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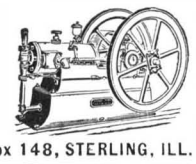

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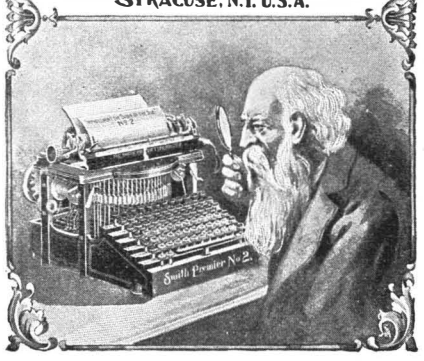

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